*AIRS*
Atmospheric Infrared Sounder

# AIRS Version 6.1.1 Released Processing Files Description


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Atmospheric Infrared Sounder

# AIRS Version 6.1.1 Processing Files Description

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# Document Change Log

| Date | Version Number | Reason for Change |
|---|---|---|
| Nov 2012 | Initial Release | |
| Dec 2014 | 6.1 | Added Level-1C |
| Aug 2016 | 6.1.1 | O3_VMR, CO_VMR, CHr_VMR units corrected in L3 |
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# 1 Introduction

## *1.1 Purpose*

This document describes the released product files for the Version 6.0.7.0 (V6.0.7.0) delivery of the AIRS Science Processing System (ASPS). These products incorporate data from the AIRS, AMSU-A (AMSU-A1 + AMSU-A2) and HSB instruments.

## *1.2 Product Overview*

Level 1B science data is calibrated instrument measurements in physical units. Data from the AIRS instrument is divided into separate products: AIRIBRAD has infrared data, while AIRVBRAD has Vis/NIR data. The corresponding AIRIBQAP and AIRVBQAP QA subset files exclude radiances and other large fields to deliver quality information in a compact format.

AIRS IR and Vis/NIR radiances are in radiance units, while MW instrument data AIRABRAD and AIRHBRAD are in brightness temperature units.

Level 1C Ir (AIRICRAD) science data has had various corrections applied in addition to calibration.

The Level 1B calibration subset product (AIRXBCAL) collects selected data from AIRS IR, Vis/NIR and AMSU-A for use in calibration.

In Level 2, atmospheric and surface quantities are estimated from the Level 1B data.

Level 2 products are cloud-cleared radiances (AIRI2CCF) and atmospheric parameters (AIRX2RET and AIRX2SUP). The standard retrieval product AIRX2RET is designed for the general user, while the support product (AIRX2SUP) contains interim and experimental portions intended for use by the AIRS team and others willing to make a significant investment of time in understanding the product.

Each Level 1B, and Level 2 science file type contains data from 6 minutes of observations in HDF-EOS Swath format.

Level 3 standard files grid data from AIRX2RET standard retrieval product in daily (AIRX3STD), eight-day (AIRX3ST8), and monthly (AIRX3STM) HDF-EOS Grid products. A more detailed set using 100-layer support profiles is included in Level-3 support products AIRX3SPD, AIRX3SP8, and AIRX3SPM. There is also a Level-3 research product for internal project use with intermediary products and quality indicators: AIRX3RED, AIRX3RE8, and AIRX3REM.

Level 3 quantized files also grid data from AIRX2RET, but, in this case, into coarser 5-day (AIRX3QP5) and monthly (AIRX3QPM) products, with information on multiple clusters within each grid cell retained.

The RaObs (AIRX2MAT) and fixed-site (AIRX2MTL) Match-Ups contain Level 1B, Level 2, and forecast data that match ground truth measurement locations in HDF-EOS Swath format.

All AIRX2, AIRI2 and AIRX3 products are produced when Level 2 is run, using AIRS and AMSU-A instruments. Variations with AIRH* are produced, using AIRS + AMSU + HSB. Variations with AIRS* are produced, using only the AIRS instrument.

AIRS products are archived at the GSFC DAAC archive. These product formats are defined in the product interface specifications, provided in Appendix A.

The basic product and QA file types are shown in Table 1.

**Table 1. Product and QA File Types**

| *ESDT Shortname* | *Mnemonic Name* |
|---|---|
| ***AIRIBRAD*** | L1B_AIRS_SCIENCE |
| ***AIRIBQAP*** | L1B_AIRS_QA |
| ***AIRVBRAD*** | L1B_VIS_SCIENCE |
| ***AIRVBQAP*** | L1B_VIS_QA |
| ***AIRABRAD*** | L1B_AMSU_SCIENCE |
| ***AIRABQAP*** | L1B_AMSU_QASup |
| ***AIRHBRAD*** | L1B_HSB_SCIENCE |
| ***AIRHBQAP*** | L1B_HSB_QASup |
| ***AIRXBCAL*** | L1B_Calibration Subset |
| ***AIRICRAD*** | L1C_AIRS_SCIENCE |
| ***AIR*2RET*** | L2_Standard_atmospheric&surface_product |
| ***AIR*2CCF*** | L2_Standard_cloud-cleared_radiance_product |
| ***AIR*2SUP*** | L2_Support_atmospheric&surface_product |
| ***AIR*3STD*** | L3_Standard_Daily |
| ***AIR*3ST8*** | L3_Standard_Multiday |
| ***AIR*3STM*** | L3_Standard_Monthly |
| ***AIR*3SPD*** | L3_Support_Daily |
| ***AIR*3SP8*** | L3_Support_Multiday |
| ***AIR*3SPM*** | L3_Support_Monthly |
| ***AIR*3RED*** | L3_Research_Daily |
| ***AIR*3RE8*** | L3_Research_Multiday |
| ***AIR*3REM*** | L3_Research_Monthly |
| ***AIR*3QP5*** | L3_Quant_Pentad |
| ***AIR*3QPM*** | L3_Quant_Monthly |

Special Note for V6.0: Level-1 products are not being updated for the v6.0 release, so the Level-1B section in Appendix A1 is unchanged from v5.0.

### *1.3 Applicable Documents*

AIRS Version 5.0 Processing Files Description, JPL D-38428, Version 1.2, November 2007

AIRS Version 4.0 Processing Files Description, JPL D-31231, Version 1.1, August 2005

AIRS Version 3.0 Processing Files Description, JPL D-26382, June 2003

AIRS Version 2.7 Processing Files Description, JPL D-25941, March 2003

AIRS Version 2.5.1 Processing Files Description, JPL D-20001, September 2002

Interface Control Document between the Earth Science Data and Information System (ESDIS) and the AIRS Science Processing Systems (ASPS), Earth Science Data and Information System Project Number 423-42-07, JPL D-22992, February 2002

Operations Agreement (OA) between the Goddard Space Flight Center (GSFC) Distributed Active Archive Center (DAAC) and the AIRS Team Leader Science Computing Facility (TLSCF), JPL D-23045, January 2002

AIRS Science Processing System Software Development Methodology, JPL D-18573, February 19, 2000

AIRS Product Generation System (PGS) Version 2.1 Requirements and Design Document, JPL D-19556, January 2001

AIRS Product Generation System (PGS) Version 1.5 Requirements and Design Document, JPL D-18926, January 2001

AIRS Product Generation System (PGS) Version 1 Requirements and Design Document (Preliminary), JPL D-17851, Version 1.1, July 1999

AIRS Version 2.0 System Description Document, Version 2.0, JPL D-19557, August 2000

AIRS Science Software Integration and Test Procedures and Agreement with the Goddard Distributed Active Archive Center, JPL D-16791, Version 3, Revision 2.0, June 1, 2000

AIRS Product Generation System (PGS) Prototype 8 Requirements and Design Document (Preliminary), JPL D-16451, Version 1.0, December 1998

AIRS Data Processing and Instrument Operations (DPIO) Software Requirements Document, JPL D-16785, Version 1.0, April 3, 1998

### *1.4 Acronymns*

| | |
|---|---|
| AIRS | Atmospheric Infrared Sounder |
| AMSU-A | Advanced Microwave Sounding Unit - Version A (AMSU-A1 and AMSU-A2) |
| APID | Application Process Identifier |
| ASPS | AIRS Science Processing System |
| AVN | Aviation (Global Forecast System Model) |
| BRTEMP | Brightness Temperature |
| DAAC | Distributed Active Archive Center |
| DECOM | Decommutation |
| DN | Data Number |
| DPIO | Data Processing and Instrument Operations |
| ECS | EOSDIS Core System |
| EDOS | EOS Data Operations Service |
| EMOS | EOS Mission Operations System |
| ENG | Engineering |
| EOS | Earth Observing System |
| ESDIS | Earth Science and Data Information System |
| ESDT | Earth Science Data Type |
| FOR | Field of Reguard |
| FOV | Field of View |
| GCM | General Circulation Model |
| GRIB | GRIdded Binary |
| GSFC | Goddard Space Flight Center |
| HSB | Humidity Sounder for Brazil |
| HDF | Hierarchical Data Format |
| ICD | Interface Control Document |
| IR | Infrared |
| L1B | Level 1B |
| L2 | Level 2 |
| L3 | Level 3 |
| LGID | Local Granule ID |
| LID | Logical ID |
| MW | Microwave |
| NCEP | National Centers for Environmental Prediction |
| NDVI | Normalized Differential Vegetation Index |
| NIR | Near Infrared |
| NOAA | National Oceanic and Atmospheric Administration |
| NWS | National Weather Service |
| OA | Operations Agreement |
| PCF | Process Control File |
| PDS | Product Description Section (NCEP Office Note 388 (ON388)) |
| PGE | Product Generation Executive |
| PGS | Product Generation System |
| PSA | Product Specific Attributes |

| | |
|---|---|
| QA | Quality Assessment |
| SCF | Science Computing Facility |
| SDPS | Science and Data Processing Segment |
| SPS | Science Processing System |
| SSI&T | Science Software Integration and Test |
| TAI | Universal Atomic Time |
| TLSCF | Team Leader Science Computing Facility |
| UR | Universal Reference |
| UTC | Coordinated Universal Time |
| Vis | Visible |
| WMO | World Meteorological Organization |

# Appendix A1. Single-Swath Fixed-Format Product Interface Specifications

Each file contains all observations of a given type made during a period of exactly 6 minutes. For each day there are 240 granules, numbered 1-240. Over the course of 6 minutes the EOS-Aqua platform travels approximately 1500 km, and the AIRS-suite instruments scan (whisk broom) a swath approximately 1500 km wide.

Start times of granules are keyed to the start of 1958. Because of leap seconds, they do not start at the same time as days do. For data from launch through 12-31-2005, granule 1 spans 00:05:26Z - 00:11:26Z and granule 240 starts at 23:59:26Z and ends at 00:05:26Z the next day. For data 12-31-2005 through the next leap second, granule 1 spans 00:05:25Z - 00:11:25Z and granule 240 starts at 23:59:25Z and ends at 00:05:25Z the next day.

These products have exactly one swath per file. The swath name is given in the interface specification.

The names of all dimensions, geolocation fields, fields and attributes are exactly as given in the "Name" column of the appropriate table, including underscores and capitalization.

The "Explanation" information, as provided in the product interface specifications, is a guide for users of the data and is not included the product files.

The contents of the "Type" column of the attribute and field tables can either specify a standard HDF type or a special AIRS type. The standard HDF types used by AIRS are:

String of 8-bit characters (Attributes only)
8-bit integer
8-bit unsigned integer
16-bit integer
16-bit unsigned integer
32-bit integer
32-bit unsigned integer
32-bit floating-point
64-bit floating-point

For all 16-bit or longer fields the value -9999 is used to flag bad or missing data. Special AIRS types are like structures, with the fields specified in tables as discussed below.

The first table of the interface specification lists "Dimensions" which are the HDF-EOS swath dimensions. The names "GeoTrack" and "GeoXTrack" have a special meaning for this document: "GeoTrack" is understood to be the dimension along the path of the spacecraft, and "GeoXTrack" is the dimension across the spacecraft track, starting on the left looking forward along the spacecraft track. Some products also contain second across-track dimension "CalXTrack," equivalent to "GeoXTrack," except that "CalXTrack" refers to the number of calibration footprints per scanline.

"GeoTrack" is 45 for large-spot (FOR) products (AMSU-A, Level-2, cloud-cleared AIRS) and 135 for small-spot (FOV) products (AIRS, Vis/NIR, HSB).

These files contain no geolocation mappings or indexed mappings.

The second table specifies "geolocation fields." These are all 64-bit floating-point fields that give the location of the data in space and time. If the note before the table specifies that these fields appear once per scanline then they have the single dimension "GeoTrack." Otherwise, they appear once per footprint per scanline and have dimensions "GeoTrack,GeoXTrack."

The third table specifies "Attributes." These are scalar or string fields that appear only once per granule. They are attributes in the HDF-EOS Swath sense.

The fourth table specifies “Per-Granule Data Fields.” These are fields that are valid for the entire granule but that are not scalars because they have some additional dimension.

The fifth table specifies "Along-Track Data Fields." These are fields that occur once for every scanline. These fields have dimension "GeoTrack" before any "Extra Dimensions." So an "Along-Track Data Field" with "Extra Dimensions" of "None" has dimensions "GeoTrack"; whereas, if the "Extra Dimensions" is "SpaceXTrack (= 4)," then it has dimensions "GeoTrack,SpaceXTrack."

The sixth table specifies "Full Swath Data Fields." These are fields that occur once for every footprint of every scanline. These have dimensions "GeoTrack,GeoXTrack" before any "Extra Dimensions." So a "Full Swath Data Field" with "Extra Dimensions" of "None" has dimensions "GeoTrack,GeoXTrack"; whereas, if the "Extra Dimensions" is "Channel (= 2378)," then it has dimensions "GeoTrack,GeoXTrack,Channel."

The last section of the interface specification may contain a table for "Special AIRS Types." These special AIRS types are used as "shorthand" for groups of fields, listed in the "Attributes," "Along-Track Data Fields" and "Full Swath Data Fields" tables as single fields. If the name of a special AIRS type appears in the "Type" column of one of these tables in place of a standard type, then there are really as many fields as there are rows in the corresponding type table, each with a name made up of the "Name" from the upper table followed by a "." and the "Field Name" from the lower table.

For example, consider a field in the "Attributes" table named "apid_415_cnt" of type "AIRS Engineering Packet Counts" (See Appendix A4.). If the table for "AIRS Engineering Packet Counts" under "Special AIRS Types" lists the three fields "missing_in," "missing_ends" and "good," then the swath contains the three fields "apid_415_cnt.missing_in," "apid_415_cnt.missing_ends," and "apid_415_cnt.good."

# A1-1. L1B AIRS Science Interface Specification

Interface Specification Version 5.0.14.0
2007-04-11

ESDT ShortName = "AIRIBRAD"

Swath Name = "L1B_AIRS_Science"

Level = "level1B"

# Footprints = 90

# scanlines per scanset = 3

## Dimensions

These fields define all dimensions that can be used for HDF-EOS swath fields.

The names "GeoTrack" and "GeoXTrack" have a special meaning for this document: "Cross-Track" data fields have a hidden dimension of "GeoXTrack"; "Along-Track" data fields have a hidden dimension of "GeoTrack"; "Full Swath" data fields have hidden dimensions of both "GeoTrack" and "GeoXTrack".

| Name | Value | Explanation |
|---|---|---|
| GeoXTrack | 90 | Dimension across track for footprint positions. Same as number of footprints per scanline. -- starting at the left and increasing towards the right as you look along the satellite's path |
| GeoTrack | # of scan lines in swath | Dimension along track for footprint positions. Same as number of scanlines in granule. Parallel to the satellite's path, increasing with time. (Nominally 45 for Level-2, AMSU-A, and AIRS/Vis low-rate engineering;<br>135 for AIRS/Vis and HSB high-rate quantities) |
| CalXTrack | 6 | Dimension "across" track for calibration footprint positions. Same as number of calibration footprints per scanline. (NUM_FOOTPRINTS_AIRS_CALIB) (Footprints are ordered: 1-4: spaceviews (ports 3, 4, 1, 2);<br>5: blackbody radiometric calibration source;<br>6: spectral/photometric calibration sources) |
| SpaceXTrack | 4 | Dimension "across" track for spaceview calibration footprint positions in order of observation time. (NUM_FOOTPRINTS_AIRS_SPACE) |
| BBXTrack | 1 | Dimension "across" track for blackbody calibration footprint positions in order of observation time. (NUM_FOOTPRINTS_AIRS_BB) |
| Channel | 2378 | Dimension of channel array (Channels are generally in order of increasing wavenumber, but because frequencies can vary and because all detectors from a physical array of detector elements (a "module") are always grouped together there are sometimes small reversals in frequency order where modules overlap.) |
| MaxRefChannel | 100 | Maximum number of radiometric reference channels. "RefChannels" lists the channels used. |
| MaxFeaturesUpwell | 35 | Maximum number of spectral features in upwelling radiances used for spectral calibration |
| MaxFeaturesPary | 17 | Maximum number of spectral features in parylene radiances used for spectral calibration |

## Geolocation Fields

These fields appear for every footprint (GeoTrack * GeoXTrack times) and correspond to footprint center coordinates and "shutter" time.

| Name | Explanation |
|---|---|
| Latitude | Footprint boresight geodetic Latitude in degrees North (-90.0 ... 90.0) |

| | |
|---|---|
| Longitude | Footprint boresight geodetic Longitude in degrees East (-180.0 ... 180.0) |
| Time | Footprint "shutter" TAI Time: floating-point elapsed seconds since Jan 1, 1993 |

## Attributes

These fields appear only once per granule and use the HDF-EOS "Attribute" interface.

| Name | Type | Explanation |
|---|---|---|
| processing_level | string of 8-bit characters | Zero-terminated character string denoting processing level ("level1B") |
| instrument | string of 8-bit characters | Zero-terminated character string denoting instrument ("AIRS") |
| DayNightFlag | string of 8-bit characters | Zero-terminated character string set to "Night" when the subsatellite points at the beginning and end of a granule are both experiencing night according to the "civil twilight" standard (center of refracted sun is below the horizon). It is set to "Day" when both are experiencing day, and "Both" when one is experiencing day and the other night. "NA" is used when a determination cannot be made. |
| AutomaticQAFlag | string of 8-bit characters | Zero-terminated character string denoting granule data quality: (Always "Passed", "Failed", or "Suspect") |
| NumTotalData | 32-bit integer | Total number of expected scene footprints |
| NumProcessData | 32-bit integer | Number of scene footprints which are present and can be processed routinely (state = 0) |
| NumSpecialData | 32-bit integer | Number of scene footprints which are present and can be processed only as a special test (state = 1) |
| NumBadData | 32-bit integer | Number of scene footprints which are present but cannot be processed (state = 2) |
| NumMissingData | 32-bit integer | Number of expected scene footprints which are not present (state = 3) |
| NumLandSurface | 32-bit integer | Number of scene footprints for which the surface is more than 90% land |
| NumOceanSurface | 32-bit integer | Number of scene footprints for which the surface is less than 10% land |
| node_type | string of 8-bit characters | Zero-terminated character string denoting whether granule is ascending, descending, or pole-crossing: ("Ascending" and "Descending" for entirely ascending or entirely descending granules, or "NorthPole" or "SouthPole" for pole-crossing granules. "NA" when determination cannot be made.) |
| start_year | 32-bit integer | Year in which granule started, UTC (e.g. 1999) |
| start_month | 32-bit integer | Month in which granule started, UTC (1 ... 12) |
| start_day | 32-bit integer | Day of month in which granule started, UTC (1 ... 31) |
| start_hour | 32-bit integer | Hour of day in which granule started, UTC (0 ... 23) |
| start_minute | 32-bit integer | Minute of hour in which granule started, UTC (0 ... 59) |
| start_sec | 32-bit floating-point | Second of minute in which granule started, UTC (0.0 ... 59.0) |
| start_orbit | 32-bit integer | Orbit number of mission in which granule started |
| end_orbit | 32-bit integer | Orbit number of mission in which granule ended |
| orbit_path | 32-bit integer | Orbit path of start orbit (1 ... 233 as defined by EOS project) |
| start_orbit_row | 32-bit integer | Orbit row at start of granule (1 ... 248 as defined by EOS project) |
| end_orbit_row | 32-bit integer | Orbit row at end of granule (1 ... 248 as defined by EOS project) |
| granule_number | 32-bit integer | Number of granule within day (1 ... 240) |
| num_scansets | 32-bit integer | Number of scansets in granule (1 ... 45) |
| num_scanlines | 32-bit integer | Number of scanlines in granule (3 * num_scansets) |
| start_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees North (-90.0 ... 90.0) |
| start_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees East (-180.0 ... 180.0) |
| start_Time | 64-bit floating-point | TAI Time at start of granule (floating-point elapsed seconds since start of 1993) |
| end_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees North (-90.0 ... 90.0) |
| end_Longitude | 64-bit floating- | Geodetic Longitude of spacecraft at end of granule (subsatellite location at |

| | | |
|---|---|---|
| | point | midpoint of last scan) in degrees East (-180.0 ... 180.0) |
| end_Time | 64-bit floating-point | TAI Time at end of granule (floating-point elapsed seconds since start of 1993) |
| eq_x_longitude | 32-bit floating-point | Longitude of spacecraft at southward equator crossing nearest granule start in degrees East (-180.0 ... 180.0) |
| eq_x_tai | 64-bit floating-point | Time of eq_x_longitude in TAI units (floating-point elapsed seconds since start of 1993) |
| orbitgeoqa | 32-bit unsigned integer | See Appendix D |
| num_satgeoqa | 16-bit integer | Number of scans with problems in satgeoqa |
| num_glintgeoqa | 16-bit integer | Number of scans with problems in glintgeoqa |
| num_moongeoqa | 16-bit integer | Number of scans with problems in moongeoqa |
| num_ftptgeoqa | 16-bit integer | Number of footprints with problems in ftptgeoqa |
| num_zengeoqa | 16-bit integer | Number of footprints with problems in zengeoqa |
| num_demgeoqa | 16-bit integer | Number of footprints with problems in demgeoqa |
| num_fpe | 16-bit integer | Number of floating point errors |
| LonGranuleCen | 16-bit integer | Geodetic Longitude of the center of the granule in degrees East (-180 ... 180) |
| LatGranuleCen | 16-bit integer | Geodetic Latitude of the center of the granule in degrees North (-90 ... 90) |
| LocTimeGranuleCen | 16-bit integer | Local solar time at the center of the granule in minutes past midnight (0 ... 1439) |
| CalGranSummary | 8-bit unsigned integer | Bit field. Bitwise OR of CalChanSummary, over all channels with ExcludedChans < 3. Zero means all good channels were well calibrated, for all scanlines. Bit 7 (MSB): scene over/underflow;<br>Bit 6: (value 64) anomaly in offset calculation;<br>Bit 5: (value 32) anomaly in gain calculation;<br>Bit 4: (value 16) pop detected;<br>Bit 3: (value 8) noise out of bounds;<br>Bit 2: (value 4) anomaly in spectral calibration;<br>Bit 1: (value 2) Telemetry;<br>Bit 0: (LSB, value 1) unused (reserved); |
| DCR_scan | 16-bit integer | Scanline number following (first) DC-Restore. 0 for no DC-Restore |
| input_bb_temp | Limited Engineering Struct (see below) | Input statistics on Blackbody temperature |
| input_bb_temp1 | Limited Engineering Struct (see below) | Input statistics on Blackbody temperature 1A (CaBbTempV1A or CaBbTempV1B, as active) |
| input_bb_temp2 | Limited Engineering Struct (see below) | Input statistics on Blackbody temperature 2 (CaBbTempV2A or CaBbTempV2B, as active) |
| input_bb_temp3 | Limited Engineering Struct (see below) | Input statistics on Blackbody temperature 3 (CaBbTemp3, active A or B) |
| input_bb_temp4 | Limited Engineering Struct (see below) | Input statistics on Blackbody temperature4 (CaBbTemp4, active A or B) |
| input_spec_temp | Limited Engineering Struct (see below) | Input statistics on Spectrometer temperature |
| input_ir_det_temp | Limited Engineering Struct (see below) | Input statistics on IR detector temperature |
| input_grating_temp_1 | Limited Engineering | Input statistics on Grating temperature 1 (SpGratngTemp1, active A or B) |

| | | |
|---|---|---|
| | Struct (see below) | |
| input_grating_temp_2 | Limited Engineering Struct (see below) | Input statistics on Grating temperature 2 (SpGratngTemp2, active A or B) |
| input_entr_filt_temp | Limited Engineering Struct (see below) | Input statistics on the entrance filter temperature (SpEntFiltTmp, active A or B) |
| input_opt_bench_temp_2 | Limited Engineering Struct (see below) | Input statistics on optical bench temperature 2 (SpOptBnchTmp2, active A or B) |
| input_opt_bench_temp_3 | Limited Engineering Struct (see below) | Input statistics on optical bench temperature 3 (SpOptBnchTmp3, active A or B) |
| input_scan_mirror_temp | Limited Engineering Struct (see below) | Input statistics on scan mirror housing temperature |
| input_chopper_phase_err | Limited Engineering Struct (see below) | Input statistics on chopper phase error voltage (ChPhaseErrVA or ChPhaseErrVB, as active) |
| PopCount | 32-bit integer | Number of popcorn events within granule, i.e. number of times than an AIRS channel used in the Level 2 retrieval has suffered a sudden discontinuity in dark current |
| NumRefChannels | 32-bit integer | The number of channels reported in MaxRefChannel arrays |
| Rdiff_swindow_M1a_chan | 16-bit integer | Array M1a channel used as one reference in calculating Rdiff_swindow. (index into radiance & frequency arrays 1...2378) |
| Rdiff_swindow_M2a_chan | 16-bit integer | Array M2a channel used as one reference in calculating Rdiff_swindow. (index into radiance & frequency arrays 1...2378) |
| Rdiff_lwindow_M8_chan | 16-bit integer | Array M8 channel used as one reference in calculating Rdiff_lwindow. (index into radiance & frequency arrays 1...2378) |
| Rdiff_lwindow_M9_chan | 16-bit integer | Array M9 channel used as one reference in calculating Rdiff_lwindow. (index into radiance & frequency arrays 1...2378) |
| CF_Version | string of 8-bit characters | Cloud Filter Version Identification. Identifies the set of thresholds used in determination of spectral_clear_indicator. |
| NumSaturatedFOVs | 16-bit unsigned integer | Number of scene fields-of-view (out of a nominal 1350) in which the downlinked counts overflowed. |
| NumUnderflowFOVs | 16-bit unsigned integer | Number of scene fields-of-view (out of a nominal 1350) in which the downlinked counts underflowed. |
| NumCalFOVsOutOfBounds | 16-bit unsigned integer | Number of calibration fields-of-view (out of a nominal 810) in which the downlinked counts underflowed or overflowed. |
| NumSO2FOVs | 16-bit unsigned integer | Number of fields-of-view (out of a nominal 1350) with a signifcant SO2 concentration based on the value of BT_diff_SO2. |
| granules_present | string of 8-bit characters | Zero-terminated character string denoting which adjacent granules were available for smoothing ("All" for both previous & next, "Prev" for previous but not next, "Next" for next but not previous, "None" for neither previous nor next) |
| spectral_TAI | 64-bit floating-point | TAI time of (first) Spectral calibration. (floating-point elapsed seconds since start of 1993) 0 for no Spectral calibration occurred in this granule. |
| spec_shift_upwell | 32-bit floating-point | Focal plane shift calculated in grating model fit to upwelling radiances (microns) |
| spec_shift_unc_upwell | 32-bit floating-point | Uncertainty of the focal plane shift calculated in the grating model fit to upwelling radiances (microns) |
| spec_fl_upwell | 32-bit floating-point | Focal length calculated in grating model fit to upwelling radiances (microns) |
| spec_fl_unc_upwell | 32-bit floating-point | Uncertainty of focal length calculated in grating model fit to upwelling radiances (microns) |

| | | |
|---|---|---|
| SpectralFeaturesUpwell | 32-bit integer | The actual number of upwelling features for MaxFeaturesUpwell-sized arrays |
| spec_iter_upwell | 16-bit integer | Number of amoeba iterations to fit the grating model to upwelling radiance feature positions |
| spec_clim_select | 16-bit integer | Number of the climatology to which the upwelling features were fitted |
| spec_shift_pary | 32-bit floating-point | Focal plane shift calculated in grating model fit to parylene radiances (microns) |
| spec_shift_unc_pary | 32-bit floating-point | Uncertainty of the focal plane shift calculated in grating model fit to parylene radiances (microns) |
| spec_fl_pary | 32-bit floating-point | Focal length calculated in grating model fit to parylene radiances (microns) |
| spec_fl_unc_pary | 32-bit floating-point | Uncertainty of focal length calculated in grating model fit to parylene radiances (microns) |
| SpectralFeaturesPary | 32-bit integer | The actual number of parylene features for MaxFeaturesPary-sized arrays |
| spec_iter_pary | 16-bit integer | Number of amoeba iterations in fit the grating model to parylene radiance feature positions |
| DCRCount | 32-bit integer | Number of times a Direct Current Restore was executed for any module |

## Per-Granule Data Fields

These fields appear only once per granule and use the HDF-EOS "Field" interface.

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| CalChanSummary | 8-bit unsigned integer | Channel (= 2378) | Bit field. Bitwise OR of CalFlag, by channel, over all scanlines. Noise threshold and spectral quality added. Zero means the channel was well calibrated for all scanlines Bit 7 (MSB): scene over/underflow;<br>Bit 6: (value 64) anomaly in offset calculation;<br>Bit 5: (value 32) anomaly in gain calculation;<br>Bit 4: (value 16) pop detected;<br>Bit 3: (value 8) noise out of bounds;<br>Bit 2: (value 4) anomaly in spectral calibration;<br>Bit 1: (value 2) Telemetry;<br>Bit 0: (LSB, value 1) unused (reserved); |
| ExcludedChans | 8-bit unsigned integer | Channel (= 2378) | An integer 0-6, indicating A/B detector weights. Used in L1B processing. 0 - A weight = B weight. Probably better that channels with state > 2;<br>1 - A-side only. Probably better that channels with state > 2;<br>2 - B-side only. Probably better that channels with state > 2;<br>3 - A weight = B weight. Probably better than channels with state = 6;<br>4 - A-side only. Probably better than channels with state = 6;<br>5 - B-side only. Probably better than channels with state = 6;<br>6 - A weight = B weight. |
| NeN | 32-bit floating-point | Channel (= 2378) | Noise-equivalent Radiance (radiance units) for an assumed 250K scene |
| input_scene_counts | Limited Engineering Struct (see below) | Channel (= 2378) | Input statistics on scene data numbers |
| input_space_counts | Limited Engineering Struct (see below) | SpaceXTrack (= 4) * Channel (= 2378) | Input statistics on spaceview data numbers |
| input_space_signals | Limited Engineering Struct (see below) | SpaceXTrack (= 4) * Channel (= 2378) | Input statistics on spaceview signals (data numbers with offset subtracted) |
| input_space_diffs | Unlimited Engineering Struct (see below) | SpaceXTrack (= 4) * Channel (= 2378) | Statistics on differences between corresponding space views, for consecutive scanlines |

| | | | |
|---|---|---|---|
| input_bb_counts | Limited Engineering Struct (see below) | Channel (= 2378) | Input statistics on blackbody calibration data numbers |
| input_bb_signals | Limited Engineering Struct (see below) | Channel (= 2378) | Input statistics on blackbody calibration signals (data numbers with offset subtracted) |
| input_spec_counts | Limited Engineering Struct (see below) | Channel (= 2378) | Input statistics on spectral calibration data numbers |
| offset_stats | Unlimited Engineering Struct (see below) | Channel (= 2378) | Statistics on offsets as of first spaceview of each scan |
| gain_stats | Unlimited Engineering Struct (see below) | Channel (= 2378) | Statistics on gains (radiance units / count) |
| rad_stats | Unlimited Engineering Struct (see below) | Channel (= 2378) | Statistics on radiances (radiance units) |
| Gain | 32-bit floating-point | Channel (= 2378) | Number of radiance units per count |
| RefChannels | 32-bit integer | MaxRefChannel (= 100) | The 1-based indexes of channels reported in MaxRefChannel arrays. Entries beyon NumRefChannels are set to -1. |
| rad_scan_stats | Unlimited Engineering Struct (see below) | GeoXTrack (= 90) * MaxRefChannel (= 100) | Statistics on scan angle dependence of radiances |
| nominal_freq | 32-bit floating-point | Channel (= 2378) | Nominal frequencies (cm**-1) of each channel |
| spectral_freq | 32-bit floating-point | Channel (= 2378) | Dynamic estimate of frequency associated with each channel (cm**-1). Note: This is a noisy estimate because there is very limited data in a single 6-minute granule. Designed for use only in aggregation to monitor instrument status. Use nominal_freq instead when analyzing data. |
| spectral_freq_unc | 32-bit floating-point | Channel (= 2378) | a signed estimate of the spectral frequency uncertainty (positive means estimated frequencies are likely too high) |
| spec_feature_shifts_upwell | 32-bit floating-point | MaxFeaturesUpwell (= 35) | Spectral shift seen for each upwelling feature, in microns at the focal plane |
| spec_feature_corr_upwell | 32-bit floating-point | MaxFeaturesUpwell (= 35) | Maximum correlation seen for each upwelling feature (0.0 ... 1.0) |
| spec_feature_sharp_upwell | 32-bit floating-point | MaxFeaturesUpwell (= 35) | Quadratic coefficient in fit to correlation for each upwelling feature |
| spec_feature_resid_upwell | 32-bit floating-point | MaxFeaturesUpwell (= 35) | Fit residual for each upwelling feature (wavenumbers) |
| spec_feature_contrast_stats | Limited Engineering Struct (see below) | MaxFeaturesUpwell (= 35) | Statistics on the spectral contrasts for each of the upwelling features, for each of the scene footprints considered for spectral calibration |
| spec_feature_shifts_pary | 32-bit floating-point | MaxFeaturesPary (= 17) | Spectral shift seen for each parylene feature, in microns at the focal plane |
| spec_feature_corr_pary | 32-bit floating-point | MaxFeaturesPary (= 17) | Maximum correlation seen for each parylene feature (0.0 ... 1.0) |
| spec_feature_sharp_pary | 32-bit floating-point | MaxFeaturesPary (= 17) | Quadratic coefficient in fit to correlation for each parylene feature |
| spec_feature_resid_pary | 32-bit floating-point | MaxFeaturesPary (= 17) | Fit residual for each parylene feature (wavenumbers) |

| | | | |
|---|---|---|---|
| ave_pary_spectrum | 32-bit floating-point | Channel (= 2378) | The average parylene spectrum (over good scanlines), in milliWatts/m**2/cm**-1/steradian |

## Along-Track Data Fields

These fields appear once per scanline (GeoTrack times).

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| satheight | 32-bit floating-point | None | Satellite altitude at nadirTAI in km above reference ellipsoid (e.g. 725.2) |
| satroll | 32-bit floating-point | None | Satellite attitude roll angle at nadirTAI (-180.0 ... 180.0 angle about the +x (roll) ORB axis, +x axis is positively oriented in the direction of orbital flight completing an orthogonal triad with y and z.) |
| satpitch | 32-bit floating-point | None | Satellite attitude pitch angle at nadirTAI (-180.0 ... 180.0 angle about +y (pitch) ORB axis. +y axis is oriented normal to the orbit plane with the positive sense opposite to that of the orbit's angular momentum vector H.) |
| satyaw | 32-bit floating-point | None | Satellite attitude yaw angle at nadirTAI (-180.0 ... 180.0 angle about +z (yaw) axis. +z axis is positively oriented Earthward parallel to the satellite radius vector R from the spacecraft center of mass to the center of the Earth.) |
| satgeoqa | 32-bit unsigned integer | None | See Appendix D |
| glintgeoqa | 16-bit unsigned integer | None | See Appendix D |
| moongeoqa | 16-bit unsigned integer | None | See Appendix D |
| nadirTAI | 64-bit floating-point | None | TAI time at which instrument is nominally looking directly down. (between footprints 15 & 16 for AMSU or between footprints 45 & 46 for AIRS/Vis & HSB) (floating-point elapsed seconds since start of 1993) |
| sat_lat | 64-bit floating-point | None | Satellite geodetic latitude in degrees North (-90.0 ... 90.0) |
| sat_lon | 64-bit floating-point | None | Satellite geodetic longitude in degrees East (-180.0 ... 180.0) |
| scan_node_type | 8-bit integer | None | 'A' for ascending, 'D' for descending, 'E' when an error is encountered in trying to determine a value. |
| glintlat | 32-bit floating-point | None | Solar glint geodetic latitude in degrees North at nadirTAI (-90.0 ... 90.0) |
| glintlon | 32-bit floating-point | None | Solar glint geodetic longitude in degrees East at nadirTAI (-180.0 ... 180.0) |
| CalScanSummary | 8-bit unsigned integer | None | Bit field. Bitwise OR of CalFlag over the all channels with ExcludedChans < 3. Zero means all "good" channels were well calibrated for this scanline Bit 7 (MSB): scene over/underflow;<br>Bit 6: (value 64) anomaly in offset calculation;<br>Bit 5: (value 32) anomaly in gain calculation;<br>Bit 4: (value 16) pop detected;<br>Bit 3: (value 8) DCR Occurred;<br>Bit 2: (value 4) Moon in View;<br>Bit 1: (value 2) telemetry out of limit condition;<br>Bit 0: (LSB, value 1) cold scene noise |
| CalFlag | 8-bit unsigned integer | Channel (= 2378) | Bit field, by channel, for the current scanline. Zero means the channel was well calibrated, for this scanline. Bit 7 (MSB): scene over/underflow;<br>Bit 6: (value 64) anomaly in offset calculation;<br>Bit 5: (value 32) anomaly in gain calculation;<br>Bit 4: (value 16) pop detected;<br>Bit 3: (value 8) DCR Occurred;<br>Bit 2: (value 4) Moon in View;<br>Bit 1: (value 2) telemetry out of limit condition; |

| | | | |
|---|---|---|---|
| | | | Bit 0: (LSB, value 1) cold scene noise |
| SpaceViewDelta | 32-bit floating-point | Channel (= 2378) | The median of the four spaceviews immediately following the Earth views in the scanline, minus the median of the spaceviews immediately preceding the Earth views in the scanline (also the magnitude of a "pop" in this scanline, when the "pop detected" bit is set in CalFlag.) (data numbers) |
| spaceview_selection | 8-bit unsigned integer | None | Indicates which footprints were included for this scan. Each bit is high when the corresponding space view is used in the spaceview offset calculation. (See L1B Processing Requirements, section 6.2);<br>LSB is first space view. |
| OpMode | 16-bit unsigned integer | None | Instrument Operations Mode. See AIRS Command Handbook, section 6.4 for a definition of each bit. Bits 0 (LSB)-2 cal phase;<br>bits 3-6 Cal Func;<br>Bit 7 quicklook (expedited) flag;<br>bits 8-11 submode Bits 12-14 Mode (0=standby, 1=ready, 2=operate, 3=checkout, 4=decontaminate, 5=off, 6=survival);<br>bit 16 transition flag |
| EDCBOARD | 16-bit unsigned integer | None | EDC A/B Powered on Indicator:;<br>0: Both sides off;<br>1: Side A;<br>2: Side B;<br>3: Invalid;<br>65534: No value downlinked |

## Full Swath Data Fields

These fields appear for every footprint of every scanline in the granule (GeoTrack * GeoXTrack times).

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| radiances | 32-bit floating-point | Channel (= 2378) | Radiances for each channel in milliWatts/m**2/cm**-1/steradian |
| scanang | 32-bit floating-point | None | Scanning angle of AIRS instrument with respect to the AIRS Instrument for this footprint (-180.0 ... 180.0, negative at start of scan, 0 at nadir) |
| ftptgeoqa | 32-bit unsigned integer | None | See Appendix D |
| zengeoqa | 16-bit unsigned integer | None | See Appendix D |
| demgeoqa | 16-bit unsigned integer | None | See Appendix D |
| satzen | 32-bit floating-point | None | Spacecraft zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| satazi | 32-bit floating-point | None | Spacecraft azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| solzen | 32-bit floating-point | None | Solar zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| solazi | 32-bit floating-point | None | Solar azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| sun_glint_distance | 16-bit integer | None | Distance (km) from footprint center to location of the sun glint (-9999 for unknown, 30000 for no glint visible because spacecraft is in Earth's shadow) |
| topog | 32-bit | None | Mean topography in meters above reference ellipsoid |

| | | | |
|---|---|---|---|
| | floating-point | | |
| topog_err | 32-bit floating-point | None | Error estimate for topog |
| landFrac | 32-bit floating-point | None | Fraction of spot that is land (0.0 ... 1.0) |
| landFrac_err | 32-bit floating-point | None | Error estimate for landFrac |
| state | 32-bit integer | None | Data state: 0:Process, 1:Special, 2:Erroneous, 3:Missing |
| Rdiff_swindow | 32-bit floating-point | None | Radiance difference in the 2560 cm**-1 window region used to warn of possible errors caused by scene non-uniformity and misalignment of the beams: radiance(Rdiff_swindow_M1a_chan) - radiance(Rdiff_swindow_M2a_chan). (radiance units) |
| Rdiff_lwindow | 32-bit floating-point | None | Radiance difference in the longwave window(850 cm**-1) used to warn of possible errors caused by scene non-uniformity and misalignment of the beams: radiance(Rdiff_lwindow_M8_chan) - radiance(Rdiff_lwindow_M9_chan). (radiance units) |
| SceneInhomogeneous | 8-bit unsigned integer | None | Threshold test for scene inhomogeneity, using band-overlap detectors (bit fields).;<br>Bit 7 (MSB, value 128): scene is inhomogeneous, as determined by the Rdiff_swindow threshold. For v5.0 the test is abs(Rdiff_swindow) > 5 * sqrt(NeN(Rdiff_swindow_M1a_chan)^2 + NeN(Rdiff_swindow_M2a_chan));<br>Bit 6 (value 64): scene is inhomogeneous, as determined by the Rdiff_lwindow threshold. For v5.0 the test is abs(Rdiff_lwindow) > 5 * sqrt(NeN(Rdiff_lwindow_M8_chan)^2 + NeN(Rdiff_lwindow_M9_chan));<br>Bits 5-0: unused (reserved) |
| dust_flag | 16-bit integer | None | Flag telling whether dust was detected in this scene;<br>1: Dust detected;<br>0: Dust not detected;<br>-1: Dust test not valid because of land;<br>-2: Dust test not valid because of high latitude;<br>-3: Dust test not valid because of suspected cloud;<br>-4: Dust test not valid because of bad input data |
| dust_score | 16-bit integer | None | Dust score. Each bit results from a different test comparing radiances. Higher scores indicate more certainty of dust present. Dust probable when score is over 380. Not valid when dust_flag is negative. |
| spectral_clear_indicator | 16-bit integer | None | Flag telling whether scene was flagged as clear by a spectral filter. Only ocean filter is validated;<br>2: Ocean test applied and scene identified as clear;<br>1: Ocean test applied and scene not identified as clear;<br>0: Calculation could not be completed. Possibly some inputs were missing or FOV is on coast or on the edge of a scan or granule;<br>-1: Unvalidated land test applied and scene not identified as clear;<br>-2: Unvalidated land test applied and scene identified as clear |
| BT_diff_SO2 | 32-bit floating-point | None | Brightness temperature difference Tb(1361.44 cm-1) - Tb(1433.06 cm-1) used as an indicator of SO2 release from volcanoes. Values under -6 K have likely volcanic SO2. (Kelvins) |

## Special AIRS Types

AIRS works around the lack of support for records in HDF-EOS Swath by grouping related fields into pseudo-records. HDF-EOS fieldnames are generated by concatenating the pseudo-record name with the subfield name, putting a "." character in between. Since these record types do not exist at the HDF-EOS swath level, reading subfield "min" of AIRS field "input_scene_counts" involves reading HDF-EOS Swath field "input_scene_counts.min".

Limited Engineering Struct: This type is used for engineering data fields for which there are known "yellow" limits.

| Field Name | Type | Explanation |
|---|---|---|
| min | 32-bit floating-point | Minimum value field takes on in granule (not valid when num_in = 0) |

| | | |
|---|---|---|
| max | 32-bit floating-point | Maximum value field takes on in granule (not valid when num_in = 0) |
| mean | 32-bit floating-point | Mean of values field takes on in granule (not valid when num_in = 0) |
| dev | 32-bit floating-point | Standard Deviation of values field takes on in granule (not valid when num_in < 2) |
| num_in | 32-bit integer | Count of in-range values field takes on in granule |
| num_lo | 32-bit integer | Count of out-of-range low values field takes on in granule |
| num_hi | 32-bit integer | Count of out-of-range high values field takes on in granule |
| num_bad | 32-bit integer | Count of occassions on which field takes on invalid flag value (-9999) in granule |
| range_min | 32-bit floating-point | Minimum in-range value. |
| range_max | 32-bit floating-point | Maximum in-range value. |
| missing | 8-bit integer | Missing limits flags. Bit 0 (LSB) is 1 when yellow low (range_min) limit is missing;<br>Bit 1 is high when yellow high (range_max) limit is missing;<br>other bits unused, set to 0. |
| max_track | 32-bit integer | GeoTrack index (counting from 1) where max was found |
| max_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where max was found |
| min_track | 32-bit integer | GeoTrack index (counting from 1) where min was found |
| min_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where min was found |

Unlimited Engineering Struct: This type is used for engineering data fields for which there are NOT known "yellow" limits.

| Field Name | Type | Explanation |
|---|---|---|
| min | 32-bit floating-point | Minimum value field takes on in granule (not valid when num = 0) |
| max | 32-bit floating-point | Maximum value field takes on in granule (not valid when num = 0) |
| mean | 32-bit floating-point | Mean of values field takes on in granule (not valid when num = 0) |
| dev | 32-bit floating-point | Standard Deviation of values field takes on in granule (not valid when num < 2) |
| num | 32-bit integer | Count of occurrences of field in granule (not including those counted in num_bad) |
| num_bad | 32-bit integer | Count of occassions on which field takes on invalid flag value (-9999) in granule |
| max_track | 32-bit integer | GeoTrack index (counting from 1) where max was found |
| max_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where max was found |
| min_track | 32-bit integer | GeoTrack index (counting from 1) where min was found |
| min_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where min was found |

# A1-2. L1B AIRS QA Interface Specification

Interface Specification Version 5.0.14.0
2007-04-11

ESDT ShortName = "AIRIBQAP"

Swath Name = "L1B_AIRS_QA"

Level = "level1B"

# Footprints = 90

# scanlines per scanset = 3

## Dimensions

These fields define all dimensions that can be used for HDF-EOS swath fields.

The names "GeoTrack" and "GeoXTrack" have a special meaning for this document: "Cross-Track" data fields have a hidden dimension of "GeoXTrack"; "Along-Track" data fields have a hidden dimension of "GeoTrack"; "Full Swath" data fields have hidden dimensions of both "GeoTrack" and "GeoXTrack".

| Name | Value | Explanation |
|---|---|---|
| GeoXTrack | 90 | Dimension across track for footprint positions. Same as number of footprints per scanline. -- starting at the left and increasing towards the right as you look along the satellite's path |
| GeoTrack | # of scan lines in swath | Dimension along track for footprint positions. Same as number of scanlines in granule. Parallel to the satellite's path, increasing with time. (Nominally 45 for Level-2, AMSU-A, and AIRS/Vis low-rate engineering;<br>135 for AIRS/Vis and HSB high-rate quantities) |
| CalXTrack | 6 | Dimension "across" track for calibration footprint positions. Same as number of calibration footprints per scanline. (NUM_FOOTPRINTS_AIRS_CALIB) (Footprints are ordered: 1-4: spaceviews (ports 3, 4, 1, 2);<br>5: blackbody radiometric calibration source;<br>6: spectral/photometric calibration sources) |
| SpaceXTrack | 4 | Dimension "across" track for spaceview calibration footprint positions in order of observation time. (NUM_FOOTPRINTS_AIRS_SPACE) |
| BBXTrack | 1 | Dimension "across" track for blackbody calibration footprint positions in order of observation time. (NUM_FOOTPRINTS_AIRS_BB) |
| Channel | 2378 | Dimension of channel array (Channels are generally in order of increasing wavenumber, but because frequencies can vary and because all detectors from a physical array of detector elements (a "module") are always grouped together there are sometimes small reversals in frequency order where modules overlap.) |
| MaxRefChannel | 100 | Maximum number of radiometric reference channels. "RefChannels" lists the channels used. |
| MaxFeaturesUpwell | 35 | Maximum number of spectral features in upwelling radiances used for spectral calibration |
| MaxFeaturesPary | 17 | Maximum number of spectral features in parylene radiances used for spectral calibration |

## Geolocation Fields

These fields appear for every footprint (GeoTrack * GeoXTrack times) and correspond to footprint center coordinates and "shutter" time.

| Name | Explanation |
|---|---|
| Latitude | Footprint boresight geodetic Latitude in degrees North (-90.0 ... 90.0) |

| | |
|---|---|
| Longitude | Footprint boresight geodetic Longitude in degrees East (-180.0 ... 180.0) |
| Time | Footprint "shutter" TAI Time: floating-point elapsed seconds since Jan 1, 1993 |

## Attributes

These fields appear only once per granule and use the HDF-EOS "Attribute" interface.

| Name | Type | Explanation |
|---|---|---|
| processing_level | string of 8-bit characters | Zero-terminated character string denoting processing level ("level1B") |
| instrument | string of 8-bit characters | Zero-terminated character string denoting instrument ("AIRS") |
| DayNightFlag | string of 8-bit characters | Zero-terminated character string set to "Night" when the subsatellite points at the beginning and end of a granule are both experiencing night according to the "civil twilight" standard (center of refracted sun is below the horizon). It is set to "Day" when both are experiencing day, and "Both" when one is experiencing day and the other night. "NA" is used when a determination cannot be made. |
| AutomaticQAFlag | string of 8-bit characters | Zero-terminated character string denoting granule data quality: (Always "Passed", "Failed", or "Suspect") |
| NumTotalData | 32-bit integer | Total number of expected scene footprints |
| NumProcessData | 32-bit integer | Number of scene footprints which are present and can be processed routinely (state = 0) |
| NumSpecialData | 32-bit integer | Number of scene footprints which are present and can be processed only as a special test (state = 1) |
| NumBadData | 32-bit integer | Number of scene footprints which are present but cannot be processed (state = 2) |
| NumMissingData | 32-bit integer | Number of expected scene footprints which are not present (state = 3) |
| NumLandSurface | 32-bit integer | Number of scene footprints for which the surface is more than 90% land |
| NumOceanSurface | 32-bit integer | Number of scene footprints for which the surface is less than 10% land |
| node_type | string of 8-bit characters | Zero-terminated character string denoting whether granule is ascending, descending, or pole-crossing: ("Ascending" and "Descending" for entirely ascending or entirely descending granules, or "NorthPole" or "SouthPole" for pole-crossing granules. "NA" when determination cannot be made.) |
| start_year | 32-bit integer | Year in which granule started, UTC (e.g. 1999) |
| start_month | 32-bit integer | Month in which granule started, UTC (1 ... 12) |
| start_day | 32-bit integer | Day of month in which granule started, UTC (1 ... 31) |
| start_hour | 32-bit integer | Hour of day in which granule started, UTC (0 ... 23) |
| start_minute | 32-bit integer | Minute of hour in which granule started, UTC (0 ... 59) |
| start_sec | 32-bit floating-point | Second of minute in which granule started, UTC (0.0 ... 59.0) |
| start_orbit | 32-bit integer | Orbit number of mission in which granule started |
| end_orbit | 32-bit integer | Orbit number of mission in which granule ended |
| orbit_path | 32-bit integer | Orbit path of start orbit (1 ... 233 as defined by EOS project) |
| start_orbit_row | 32-bit integer | Orbit row at start of granule (1 ... 248 as defined by EOS project) |
| end_orbit_row | 32-bit integer | Orbit row at end of granule (1 ... 248 as defined by EOS project) |
| granule_number | 32-bit integer | Number of granule within day (1 ... 240) |
| num_scansets | 32-bit integer | Number of scansets in granule (1 ... 45) |
| num_scanlines | 32-bit integer | Number of scanlines in granule (3 * num_scansets) |
| start_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees North (-90.0 ... 90.0) |
| start_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees East (-180.0 ... 180.0) |
| start_Time | 64-bit floating-point | TAI Time at start of granule (floating-point elapsed seconds since start of 1993) |
| end_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees North (-90.0 ... 90.0) |
| end_Longitude | 64-bit floating- | Geodetic Longitude of spacecraft at end of granule (subsatellite location at |

| | | |
|---|---|---|
| | point | midpoint of last scan) in degrees East (-180.0 ... 180.0) |
| end_Time | 64-bit floating-point | TAI Time at end of granule (floating-point elapsed seconds since start of 1993) |
| eq_x_longitude | 32-bit floating-point | Longitude of spacecraft at southward equator crossing nearest granule start in degrees East (-180.0 ... 180.0) |
| eq_x_tai | 64-bit floating-point | Time of eq_x_longitude in TAI units (floating-point elapsed seconds since start of 1993) |
| orbitgeoqa | 32-bit unsigned integer | See Appendix D |
| num_satgeoqa | 16-bit integer | Number of scans with problems in satgeoqa |
| num_glintgeoqa | 16-bit integer | Number of scans with problems in glintgeoqa |
| num_moongeoqa | 16-bit integer | Number of scans with problems in moongeoqa |
| num_ftptgeoqa | 16-bit integer | Number of footprints with problems in ftptgeoqa |
| num_zengeoqa | 16-bit integer | Number of footprints with problems in zengeoqa |
| num_demgeoqa | 16-bit integer | Number of footprints with problems in demgeoqa |
| num_fpe | 16-bit integer | Number of floating point errors |
| LonGranuleCen | 16-bit integer | Geodetic Longitude of the center of the granule in degrees East (-180 ... 180) |
| LatGranuleCen | 16-bit integer | Geodetic Latitude of the center of the granule in degrees North (-90 ... 90) |
| LocTimeGranuleCen | 16-bit integer | Local solar time at the center of the granule in minutes past midnight (0 ... 1439) |
| CalGranSummary | 8-bit unsigned integer | Bit field. Bitwise OR of CalChanSummary, over all channels with ExcludedChans < 3. Zero means all good channels were well calibrated, for all scanlines. Bit 7 (MSB): scene over/underflow;<br>Bit 6: (value 64) anomaly in offset calculation;<br>Bit 5: (value 32) anomaly in gain calculation;<br>Bit 4: (value 16) pop detected;<br>Bit 3: (value 8) noise out of bounds;<br>Bit 2: (value 4) anomaly in spectral calibration;<br>Bit 1: (value 2) Telemetry;<br>Bit 0: (LSB, value 1) unused (reserved); |
| DCR_scan | 16-bit integer | Scanline number following (first) DC-Restore. 0 for no DC-Restore |
| input_bb_temp | Limited Engineering Struct (see below) | Input statistics on Blackbody temperature |
| input_bb_temp1 | Limited Engineering Struct (see below) | Input statistics on Blackbody temperature 1A (CaBbTempV1A or CaBbTempV1B, as active) |
| input_bb_temp2 | Limited Engineering Struct (see below) | Input statistics on Blackbody temperature 2 (CaBbTempV2A or CaBbTempV2B, as active) |
| input_bb_temp3 | Limited Engineering Struct (see below) | Input statistics on Blackbody temperature 3 (CaBbTemp3, active A or B) |
| input_bb_temp4 | Limited Engineering Struct (see below) | Input statistics on Blackbody temperature4 (CaBbTemp4, active A or B) |
| input_spec_temp | Limited Engineering Struct (see below) | Input statistics on Spectrometer temperature |
| input_ir_det_temp | Limited Engineering Struct (see below) | Input statistics on IR detector temperature |
| input_grating_temp_1 | Limited Engineering | Input statistics on Grating temperature 1 (SpGratngTemp1, active A or B) |

| | | |
|---|---|---|
| | Struct (see below) | |
| input_grating_temp_2 | Limited Engineering Struct (see below) | Input statistics on Grating temperature 2 (SpGratngTemp2, active A or B) |
| input_entr_filt_temp | Limited Engineering Struct (see below) | Input statistics on the entrance filter temperature (SpEntFiltTmp, active A or B) |
| input_opt_bench_temp_2 | Limited Engineering Struct (see below) | Input statistics on optical bench temperature 2 (SpOptBnchTmp2, active A or B) |
| input_opt_bench_temp_3 | Limited Engineering Struct (see below) | Input statistics on optical bench temperature 3 (SpOptBnchTmp3, active A or B) |
| input_scan_mirror_temp | Limited Engineering Struct (see below) | Input statistics on scan mirror housing temperature |
| input_chopper_phase_err | Limited Engineering Struct (see below) | Input statistics on chopper phase error voltage (ChPhaseErrVA or ChPhaseErrVB, as active) |
| PopCount | 32-bit integer | Number of popcorn events within granule, i.e. number of times than an AIRS channel used in the Level 2 retrieval has suffered a sudden discontinuity in dark current |
| NumRefChannels | 32-bit integer | The number of channels reported in MaxRefChannel arrays |
| Rdiff_swindow_M1a_chan | 16-bit integer | Array M1a channel used as one reference in calculating Rdiff_swindow. (index into radiance & frequency arrays 1...2378) |
| Rdiff_swindow_M2a_chan | 16-bit integer | Array M2a channel used as one reference in calculating Rdiff_swindow. (index into radiance & frequency arrays 1...2378) |
| Rdiff_lwindow_M8_chan | 16-bit integer | Array M8 channel used as one reference in calculating Rdiff_lwindow. (index into radiance & frequency arrays 1...2378) |
| Rdiff_lwindow_M9_chan | 16-bit integer | Array M9 channel used as one reference in calculating Rdiff_lwindow. (index into radiance & frequency arrays 1...2378) |
| CF_Version | string of 8-bit characters | Cloud Filter Version Identification. Identifies the set of thresholds used in determination of spectral_clear_indicator. |
| NumSaturatedFOVs | 16-bit unsigned integer | Number of scene fields-of-view (out of a nominal 1350) in which the downlinked counts overflowed. |
| NumUnderflowFOVs | 16-bit unsigned integer | Number of scene fields-of-view (out of a nominal 1350) in which the downlinked counts underflowed. |
| NumCalFOVsOutOfBounds | 16-bit unsigned integer | Number of calibration fields-of-view (out of a nominal 810) in which the downlinked counts underflowed or overflowed. |
| NumSO2FOVs | 16-bit unsigned integer | Number of fields-of-view (out of a nominal 1350) with a signifcant SO2 concentration based on the value of BT_diff_SO2. |
| granules_present | string of 8-bit characters | Zero-terminated character string denoting which adjacent granules were available for smoothing ("All" for both previous & next, "Prev" for previous but not next, "Next" for next but not previous, "None" for neither previous nor next) |
| spectral_TAI | 64-bit floating-point | TAI time of (first) Spectral calibration. (floating-point elapsed seconds since start of 1993) 0 for no Spectral calibration occurred in this granule. |
| spec_shift_upwell | 32-bit floating-point | Focal plane shift calculated in grating model fit to upwelling radiances (microns) |
| spec_shift_unc_upwell | 32-bit floating-point | Uncertainty of the focal plane shift calculated in the grating model fit to upwelling radiances (microns) |
| spec_fl_upwell | 32-bit floating-point | Focal length calculated in grating model fit to upwelling radiances (microns) |
| spec_fl_unc_upwell | 32-bit floating-point | Uncertainty of focal length calculated in grating model fit to upwelling radiances (microns) |

| | | |
|---|---|---|
| SpectralFeaturesUpwell | 32-bit integer | The actual number of upwelling features for MaxFeaturesUpwell-sized arrays |
| spec_iter_upwell | 16-bit integer | Number of amoeba iterations to fit the grating model to upwelling radiance feature positions |
| spec_clim_select | 16-bit integer | Number of the climatology to which the upwelling features were fitted |
| spec_shift_pary | 32-bit floating-point | Focal plane shift calculated in grating model fit to parylene radiances (microns) |
| spec_shift_unc_pary | 32-bit floating-point | Uncertainty of the focal plane shift calculated in grating model fit to parylene radiances (microns) |
| spec_fl_pary | 32-bit floating-point | Focal length calculated in grating model fit to parylene radiances (microns) |
| spec_fl_unc_pary | 32-bit floating-point | Uncertainty of focal length calculated in grating model fit to parylene radiances (microns) |
| SpectralFeaturesPary | 32-bit integer | The actual number of parylene features for MaxFeaturesPary-sized arrays |
| spec_iter_pary | 16-bit integer | Number of amoeba iterations in fit the grating model to parylene radiance feature positions |
| DCRCount | 32-bit integer | Number of times a Direct Current Restore was executed for any module |

## Per-Granule Data Fields

These fields appear only once per granule and use the HDF-EOS "Field" interface.

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| CalChanSummary | 8-bit unsigned integer | Channel (= 2378) | Bit field. Bitwise OR of CalFlag, by channel, over all scanlines. Noise threshold and spectral quality added. Zero means the channel was well calibrated for all scanlines Bit 7 (MSB): scene over/underflow;<br>Bit 6: (value 64) anomaly in offset calculation;<br>Bit 5: (value 32) anomaly in gain calculation;<br>Bit 4: (value 16) pop detected;<br>Bit 3: (value 8) noise out of bounds;<br>Bit 2: (value 4) anomaly in spectral calibration;<br>Bit 1: (value 2) Telemetry;<br>Bit 0: (LSB, value 1) unused (reserved); |
| ExcludedChans | 8-bit unsigned integer | Channel (= 2378) | An integer 0-6, indicating A/B detector weights. Used in L1B processing. 0 - A weight = B weight. Probably better that channels with state > 2;<br>1 - A-side only. Probably better that channels with state > 2;<br>2 - B-side only. Probably better that channels with state > 2;<br>3 - A weight = B weight. Probably better than channels with state = 6;<br>4 - A-side only. Probably better than channels with state = 6;<br>5 - B-side only. Probably better than channels with state = 6;<br>6 - A weight = B weight. |
| NeN | 32-bit floating-point | Channel (= 2378) | Noise-equivalent Radiance (radiance units) for an assumed 250K scene |
| input_scene_counts | Limited Engineering Struct (see below) | Channel (= 2378) | Input statistics on scene data numbers |
| input_space_counts | Limited Engineering Struct (see below) | SpaceXTrack (= 4) * Channel (= 2378) | Input statistics on spaceview data numbers |
| input_space_signals | Limited Engineering Struct (see below) | SpaceXTrack (= 4) * Channel (= 2378) | Input statistics on spaceview signals (data numbers with offset subtracted) |
| input_space_diffs | Unlimited Engineering Struct (see below) | SpaceXTrack (= 4) * Channel (= 2378) | Statistics on differences between corresponding space views, for consecutive scanlines |

| | | | |
|---|---|---|---|
| input_bb_counts | Limited Engineering Struct (see below) | Channel (= 2378) | Input statistics on blackbody calibration data numbers |
| input_bb_signals | Limited Engineering Struct (see below) | Channel (= 2378) | Input statistics on blackbody calibration signals (data numbers with offset subtracted) |
| input_spec_counts | Limited Engineering Struct (see below) | Channel (= 2378) | Input statistics on spectral calibration data numbers |
| offset_stats | Unlimited Engineering Struct (see below) | Channel (= 2378) | Statistics on offsets as of first spaceview of each scan |
| gain_stats | Unlimited Engineering Struct (see below) | Channel (= 2378) | Statistics on gains (radiance units / count) |
| rad_stats | Unlimited Engineering Struct (see below) | Channel (= 2378) | Statistics on radiances (radiance units) |
| Gain | 32-bit floating-point | Channel (= 2378) | Number of radiance units per count |
| RefChannels | 32-bit integer | MaxRefChannel (= 100) | The 1-based indexes of channels reported in MaxRefChannel arrays. Entries beyon NumRefChannels are set to -1. |
| rad_scan_stats | Unlimited Engineering Struct (see below) | GeoXTrack (= 90) * MaxRefChannel (= 100) | Statistics on scan angle dependence of radiances |
| nominal_freq | 32-bit floating-point | Channel (= 2378) | Nominal frequencies (cm**-1) of each channel |
| spectral_freq | 32-bit floating-point | Channel (= 2378) | Dynamic estimate of frequency associated with each channel (cm**-1). Note: This is a noisy estimate because there is very limited data in a single 6-minute granule. Designed for use only in aggregation to monitor instrument status. Use nominal_freq instead when analyzing data. |
| spectral_freq_unc | 32-bit floating-point | Channel (= 2378) | a signed estimate of the spectral frequency uncertainty (positive means estimated frequencies are likely too high) |
| spec_feature_shifts_upwell | 32-bit floating-point | MaxFeaturesUpwell (= 35) | Spectral shift seen for each upwelling feature, in microns at the focal plane |
| spec_feature_corr_upwell | 32-bit floating-point | MaxFeaturesUpwell (= 35) | Maximum correlation seen for each upwelling feature (0.0 ... 1.0) |
| spec_feature_sharp_upwell | 32-bit floating-point | MaxFeaturesUpwell (= 35) | Quadratic coefficient in fit to correlation for each upwelling feature |
| spec_feature_resid_upwell | 32-bit floating-point | MaxFeaturesUpwell (= 35) | Fit residual for each upwelling feature (wavenumbers) |
| spec_feature_contrast_stats | Limited Engineering Struct (see below) | MaxFeaturesUpwell (= 35) | Statistics on the spectral contrasts for each of the upwelling features, for each of the scene footprints considered for spectral calibration |
| spec_feature_shifts_pary | 32-bit floating-point | MaxFeaturesPary (= 17) | Spectral shift seen for each parylene feature, in microns at the focal plane |
| spec_feature_corr_pary | 32-bit floating-point | MaxFeaturesPary (= 17) | Maximum correlation seen for each parylene feature (0.0 ... 1.0) |
| spec_feature_sharp_pary | 32-bit floating-point | MaxFeaturesPary (= 17) | Quadratic coefficient in fit to correlation for each parylene feature |
| spec_feature_resid_pary | 32-bit floating-point | MaxFeaturesPary (= 17) | Fit residual for each parylene feature (wavenumbers) |

| | | | |
|---|---|---|---|
| ave_pary_spectrum | 32-bit floating-point | Channel (= 2378) | The average parylene spectrum (over good scanlines), in milliWatts/m**2/cm**-1/steradian |

## Along-Track Data Fields

These fields appear once per scanline (GeoTrack times).

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| satheight | 32-bit floating-point | None | Satellite altitude at nadirTAI in km above reference ellipsoid (e.g. 725.2) |
| satroll | 32-bit floating-point | None | Satellite attitude roll angle at nadirTAI (-180.0 ... 180.0 angle about the +x (roll) ORB axis, +x axis is positively oriented in the direction of orbital flight completing an orthogonal triad with y and z.) |
| satpitch | 32-bit floating-point | None | Satellite attitude pitch angle at nadirTAI (-180.0 ... 180.0 angle about +y (pitch) ORB axis. +y axis is oriented normal to the orbit plane with the positive sense opposite to that of the orbit's angular momentum vector H.) |
| satyaw | 32-bit floating-point | None | Satellite attitude yaw angle at nadirTAI (-180.0 ... 180.0 angle about +z (yaw) axis. +z axis is positively oriented Earthward parallel to the satellite radius vector R from the spacecraft center of mass to the center of the Earth.) |
| satgeoqa | 32-bit unsigned integer | None | See Appendix D |
| glintgeoqa | 16-bit unsigned integer | None | See Appendix D |
| moongeoqa | 16-bit unsigned integer | None | See Appendix D |
| nadirTAI | 64-bit floating-point | None | TAI time at which instrument is nominally looking directly down. (between footprints 15 & 16 for AMSU or between footprints 45 & 46 for AIRS/Vis & HSB) (floating-point elapsed seconds since start of 1993) |
| sat_lat | 64-bit floating-point | None | Satellite geodetic latitude in degrees North (-90.0 ... 90.0) |
| sat_lon | 64-bit floating-point | None | Satellite geodetic longitude in degrees East (-180.0 ... 180.0) |
| scan_node_type | 8-bit integer | None | 'A' for ascending, 'D' for descending, 'E' when an error is encountered in trying to determine a value. |
| glintlat | 32-bit floating-point | None | Solar glint geodetic latitude in degrees North at nadirTAI (-90.0 ... 90.0) |
| glintlon | 32-bit floating-point | None | Solar glint geodetic longitude in degrees East at nadirTAI (-180.0 ... 180.0) |
| CalScanSummary | 8-bit unsigned integer | None | Bit field. Bitwise OR of CalFlag over the all channels with ExcludedChans < 3. Zero means all "good" channels were well calibrated for this scanline Bit 7 (MSB): scene over/underflow;<br>Bit 6: (value 64) anomaly in offset calculation;<br>Bit 5: (value 32) anomaly in gain calculation;<br>Bit 4: (value 16) pop detected;<br>Bit 3: (value 8) DCR Occurred;<br>Bit 2: (value 4) Moon in View;<br>Bit 1: (value 2) telemetry out of limit condition;<br>Bit 0: (LSB, value 1) cold scene noise |
| CalFlag | 8-bit unsigned integer | Channel (= 2378) | Bit field, by channel, for the current scanline. Zero means the channel was well calibrated, for this scanline. Bit 7 (MSB): scene over/underflow;<br>Bit 6: (value 64) anomaly in offset calculation;<br>Bit 5: (value 32) anomaly in gain calculation;<br>Bit 4: (value 16) pop detected;<br>Bit 3: (value 8) DCR Occurred;<br>Bit 2: (value 4) Moon in View;<br>Bit 1: (value 2) telemetry out of limit condition; |

| | | | |
|---|---|---|---|
| | | | Bit 0: (LSB, value 1) cold scene noise |
| SpaceViewDelta | 32-bit floating-point | Channel (= 2378) | The median of the four spaceviews immediately following the Earth views in the scanline, minus the median of the spaceviews immediately preceding the Earth views in the scanline (also the magnitude of a "pop" in this scanline, when the "pop detected" bit is set in CalFlag.) (data numbers) |
| spaceview_selection | 8-bit unsigned integer | None | Indicates which footprints were included for this scan. Each bit is high when the corresponding space view is used in the spaceview offset calculation. (See L1B Processing Requirements, section 6.2);<br>LSB is first space view. |
| OpMode | 16-bit unsigned integer | None | Instrument Operations Mode. See AIRS Command Handbook, section 6.4 for a definition of each bit. Bits 0 (LSB)-2 cal phase;<br>bits 3-6 Cal Func;<br>Bit 7 quicklook (expedited) flag;<br>bits 8-11 submode Bits 12-14 Mode (0=standby, 1=ready, 2=operate, 3=checkout, 4=decontaminate, 5=off, 6=survival);<br>bit 16 transition flag |
| EDCBOARD | 16-bit unsigned integer | None | EDC A/B Powered on Indicator:;<br>0: Both sides off;<br>1: Side A;<br>2: Side B;<br>3: Invalid;<br>65534: No value downlinked |

## Full Swath Data Fields

These fields appear for every footprint of every scanline in the granule (GeoTrack * GeoXTrack times).

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| scanang | 32-bit floating-point | None | Scanning angle of AIRS instrument with respect to the AIRS Instrument for this footprint (-180.0 ... 180.0, negative at start of scan, 0 at nadir) |
| ftptgeoqa | 32-bit unsigned integer | None | See Appendix D |
| zengeoqa | 16-bit unsigned integer | None | See Appendix D |
| demgeoqa | 16-bit unsigned integer | None | See Appendix D |
| satzen | 32-bit floating-point | None | See Appendix D |
| satazi | 32-bit floating-point | None | Spacecraft azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| solzen | 32-bit floating-point | None | Solar zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| solazi | 32-bit floating-point | None | Solar azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| sun_glint_distance | 16-bit integer | None | Distance (km) from footprint center to location of the sun glint (-9999 for unknown, 30000 for no glint visible because spacecraft is in Earth's shadow) |
| topog | 32-bit floating-point | None | Mean topography in meters above reference ellipsoid |
| topog_err | 32-bit | None | Error estimate for topog |

| | | | |
|---|---|---|---|
| | floating-point | | |
| landFrac | 32-bit floating-point | None | Fraction of spot that is land (0.0 ... 1.0) |
| landFrac_err | 32-bit floating-point | None | Error estimate for landFrac |
| state | 32-bit integer | None | Data state: 0:Process, 1:Special, 2:Erroneous, 3:Missing |
| Rdiff_swindow | 32-bit floating-point | None | Radiance difference in the 2560 cm**-1 window region used to warn of possible errors caused by scene non-uniformity and misalignment of the beams: radiance(Rdiff_swindow_M1a_chan) - radiance(Rdiff_swindow_M2a_chan). (radiance units) |
| Rdiff_lwindow | 32-bit floating-point | None | Radiance difference in the longwave window(850 cm**-1) used to warn of possible errors caused by scene non-uniformity and misalignment of the beams: radiance(Rdiff_lwindow_M8_chan) - radiance(Rdiff_lwindow_M9_chan). (radiance units) |
| SceneInhomogeneous | 8-bit unsigned integer | None | Threshold test for scene inhomogeneity, using band-overlap detectors (bit fields).;<br>Bit 7 (MSB, value 128): scene is inhomogeneous, as determined by the Rdiff_swindow threshold. For v5.0 the test is abs(Rdiff_swindow) > 5 * sqrt(NeN(Rdiff_swindow_M1a_chan)^2 + NeN(Rdiff_swindow_M2a_chan));<br>Bit 6 (value 64): scene is inhomogeneous, as determined by the Rdiff_lwindow threshold. For v5.0 the test is abs(Rdiff_lwindow) > 5 * sqrt(NeN(Rdiff_lwindow_M8_chan)^2 + NeN(Rdiff_lwindow_M9_chan));<br>Bits 5-0: unused (reserved) |
| dust_flag | 16-bit integer | None | Flag telling whether dust was detected in this scene;<br>1: Dust detected;<br>0: Dust not detected;<br>-1: Dust test not valid because of land;<br>-2: Dust test not valid because of high latitude;<br>-3: Dust test not valid because of suspected cloud;<br>-4: Dust test not valid because of bad input data |
| dust_score | 16-bit integer | None | Dust score. Each bit results from a different test comparing radiances. Higher scores indicate more certainty of dust present. Dust probable when score is over 380. Not valid when dust_flag is negative. |
| spectral_clear_indicator | 16-bit integer | None | Flag telling whether scene was flagged as clear by a spectral filter. Only ocean filter is validated;<br>2: Ocean test applied and scene identified as clear;<br>1: Ocean test applied and scene not identified as clear;<br>0: Calculation could not be completed. Possibly some inputs were missing or FOV is on coast or on the edge of a scan or granule;<br>-1: Unvalidated land test applied and scene not identified as clear;<br>-2: Unvalidated land test applied and scene identified as clear |
| BT_diff_SO2 | 32-bit floating-point | None | Brightness temperature difference Tb(1361.44 cm-1) - Tb(1433.06 cm-1) used as an indicator of SO2 release from volcanoes. Values under -6 K have likely volcanic SO2. (Kelvins) |

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## Special AIRS Types

AIRS works around the lack of support for records in HDF-EOS Swath by grouping related fields into pseudo-records. HDF-EOS fieldnames are generated by concatenating the pseudo-record name with the subfield name, putting a "." character in between. Since these record types do not exist at the HDF-EOS swath level, reading subfield "min" of AIRS field "input_scene_counts" involves reading HDF-EOS Swath field "input_scene_counts.min".

Limited Engineering Struct: This type is used for engineering data fields for which there are known "yellow" limits.

| Field Name | Type | Explanation |
|---|---|---|
| min | 32-bit floating-point | Minimum value field takes on in granule (not valid when num_in = 0) |

| | | |
|---|---|---|
| max | 32-bit floating-point | Maximum value field takes on in granule (not valid when num_in = 0) |
| mean | 32-bit floating-point | Mean of values field takes on in granule (not valid when num_in = 0) |
| dev | 32-bit floating-point | Standard Deviation of values field takes on in granule (not valid when num_in < 2) |
| num_in | 32-bit integer | Count of in-range values field takes on in granule |
| num_lo | 32-bit integer | Count of out-of-range low values field takes on in granule |
| num_hi | 32-bit integer | Count of out-of-range high values field takes on in granule |
| num_bad | 32-bit integer | Count of occassions on which field takes on invalid flag value (-9999) in granule |
| range_min | 32-bit floating-point | Minimum in-range value. |
| range_max | 32-bit floating-point | Maximum in-range value. |
| missing | 8-bit integer | Missing limits flags. Bit 0 (LSB) is 1 when yellow low (range_min) limit is missing;<br>Bit 1 is high when yellow high (range_max) limit is missing;<br>other bits unused, set to 0. |
| max_track | 32-bit integer | GeoTrack index (counting from 1) where max was found |
| max_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where max was found |
| min_track | 32-bit integer | GeoTrack index (counting from 1) where min was found |
| min_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where min was found |

Unlimited Engineering Struct: This type is used for engineering data fields for which there are NOT known "yellow" limits.

| Field Name | Type | Explanation |
|---|---|---|
| min | 32-bit floating-point | Minimum value field takes on in granule (not valid when num = 0) |
| max | 32-bit floating-point | Maximum value field takes on in granule (not valid when num = 0) |
| mean | 32-bit floating-point | Mean of values field takes on in granule (not valid when num = 0) |
| dev | 32-bit floating-point | Standard Deviation of values field takes on in granule (not valid when num < 2) |
| num | 32-bit integer | Count of occurrences of field in granule (not including those counted in num_bad) |
| num_bad | 32-bit integer | Count of occassions on which field takes on invalid flag value (-9999) in granule |
| max_track | 32-bit integer | GeoTrack index (counting from 1) where max was found |
| max_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where max was found |
| min_track | 32-bit integer | GeoTrack index (counting from 1) where min was found |
| min_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where min was found |

# A1-3. L1B Visible/NIR Science Interface Specification

Interface Specification Version 5.0.14.0
2007-04-11

ESDT ShortName = "AIRVBRAD"

Swath Name = "L1B_VIS_Science"

Level = "level1B"

# Footprints = 90

# scanlines per scanset = 3

## Dimensions

These fields define all dimensions that can be used for HDF-EOS swath fields.

The names "GeoTrack" and "GeoXTrack" have a special meaning for this document: "Cross-Track" data fields have a hidden dimension of "GeoXTrack"; "Along-Track" data fields have a hidden dimension of "GeoTrack"; "Full Swath" data fields have hidden dimensions of both "GeoTrack" and "GeoXTrack".

| Name | Value | Explanation |
|---|---|---|
| GeoXTrack | 90 | Dimension across track for footprint positions. Same as number of footprints per scanline. -- starting at the left and increasing towards the right as you look along the satellite's path |
| GeoTrack | # of scan lines in swath | Dimension along track for footprint positions. Same as number of scanlines in granule. Parallel to the satellite's path, increasing with time. (Nominally 45 for Level-2, AMSU-A, and AIRS/Vis low-rate engineering;<br>135 for AIRS/Vis and HSB high-rate quantities) |
| SubTrack | 9 | VIS detector elements per AIRS footprint along track (9). Direction is the same as GeoTrack -- parallel to the satellite's path, increasing with time. (opposite order to detector ordering -- detector 0 is last) |
| SubXTrack | 8 | VIS samples per AIRS footprint across track (8). Direction is the same as GeoXTrack -- starting at the left and increasing towards the right as you look along the satellite's path |
| GeoLocationsPerSpot | 4 | Geolocations for the 4 corner pixels in the order: trailing first scanned;<br>trailing last-scanned;<br>leading first-scanned;<br>leading last-scanned. Each footprint also has a central geolocation associated with the swath geolocation lat/lon/time of the footprint. |
| Channel | 4 | Dimension of channel array (Channel 1: ~0.40 micron;<br>Ch 2: ~0.6 micron;<br>Ch 3: ~0.8 micron;<br>Ch 4: broadband) |

## Geolocation Fields

These fields appear for every footprint (GeoTrack * GeoXTrack times) and correspond to footprint center coordinates and "shutter" time.

| Name | Explanation |
|---|---|
| Latitude | Footprint boresight geodetic Latitude in degrees North (-90.0 ... 90.0) |
| Longitude | Footprint boresight geodetic Longitude in degrees East (-180.0 ... 180.0) |
| Time | Footprint "shutter" TAI Time: floating-point elapsed seconds since Jan 1, 1993 |

## Attributes

These fields appear only once per granule and use the HDF-EOS "Attribute" interface.

| Name | Type | Explanation |
|---|---|---|
| VISDarkAMSUFOVCount | 32-bit integer | Number of AMSU-A footprints that are uniformly dark in the level-1B VIS/NIR and are thus likely to be uniformly clear |
| VISBrightAMSUFOVCount | 32-bit integer | Number of AMSU-A footprints that are uniformly bright in the level-1B VIS/NIR and are thus likely to be uniformly cloudy |
| processing_level | string of 8-bit characters | Zero-terminated character string denoting processing level ("level1B") |
| instrument | string of 8-bit characters | Zero-terminated character string denoting instrument ("VIS") |
| DayNightFlag | string of 8-bit characters | Zero-terminated character string set to "Night" when the subsatellite points at the beginning and end of a granule are both experiencing night according to the "civil twilight" standard (center of refracted sun is below the horizon). It is set to "Day" when both are experiencing day, and "Both" when one is experiencing day and the other night. "NA" is used when a determination cannot be made. |
| AutomaticQAFlag | string of 8-bit characters | Zero-terminated character string denoting granule data quality: (Always "Passed", "Failed", or "Suspect") |
| NumTotalData | 32-bit integer | Total number of expected scene footprints |
| NumProcessData | 32-bit integer | Number of scene footprints which are present and can be processed routinely (state = 0) |
| NumSpecialData | 32-bit integer | Number of scene footprints which are present and can be processed only as a special test (state = 1) |
| NumBadData | 32-bit integer | Number of scene footprints which are present but cannot be processed (state = 2) |
| NumMissingData | 32-bit integer | Number of expected scene footprints which are not present (state = 3) |
| NumLandSurface | 32-bit integer | Number of scene footprints for which the surface is more than 90% land |
| NumOceanSurface | 32-bit integer | Number of scene footprints for which the surface is less than 10% land |
| node_type | string of 8-bit characters | Zero-terminated character string denoting whether granule is ascending, descending, or pole-crossing: ("Ascending" and "Descending" for entirely ascending or entirely descending granules, or "NorthPole" or "SouthPole" for pole-crossing granules. "NA" when determination cannot be made.) |
| start_year | 32-bit integer | Year in which granule started, UTC (e.g. 1999) |
| start_month | 32-bit integer | Month in which granule started, UTC (1 ... 12) |
| start_day | 32-bit integer | Day of month in which granule started, UTC (1 ... 31) |
| start_hour | 32-bit integer | Hour of day in which granule started, UTC (0 ... 23) |
| start_minute | 32-bit integer | Minute of hour in which granule started, UTC (0 ... 59) |
| start_sec | 32-bit floating-point | Second of minute in which granule started, UTC (0.0 ... 59.0) |
| start_orbit | 32-bit integer | Orbit number of mission in which granule started |
| end_orbit | 32-bit integer | Orbit number of mission in which granule ended |
| orbit_path | 32-bit integer | Orbit path of start orbit (1 ... 233 as defined by EOS project) |
| start_orbit_row | 32-bit integer | Orbit row at start of granule (1 ... 248 as defined by EOS project) |
| end_orbit_row | 32-bit integer | Orbit row at end of granule (1 ... 248 as defined by EOS project) |
| granule_number | 32-bit integer | Number of granule within day (1 ... 240) |
| num_scansets | 32-bit integer | Number of scansets in granule (1 ... 45) |
| num_scanlines | 32-bit integer | Number of scanlines in granule (3 * num_scansets) |
| start_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees North (-90.0 ... 90.0) |
| start_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at start of granule (subsatellite location atmidpoint of first scan) in degrees East (-180.0 ... 180.0) |
| start_Time | 64-bit floating-point | TAI Time at start of granule (floating-point elapsed seconds since start of 1993) |
| end_Latitude | 64-bit floating- | Geodetic Latitude of spacecraft at end of granule (subsatellite location at midpoint |

| | | |
|---|---|---|
| | point | of last scan) in degrees North (-90.0 ... 90.0) |
| end_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees East (-180.0 ... 180.0) |
| end_Time | 64-bit floating-point | TAI Time at end of granule (floating-point elapsed seconds since start of 1993) |
| eq_x_longitude | 32-bit floating-point | Longitude of spacecraft at southward equator crossing nearest granule start in degrees East (-180.0 ... 180.0) |
| eq_x_tai | 64-bit floating-point | Time of eq_x_longitude in TAI units (floating-point elapsed seconds since start of 1993) |
| orbitgeoqa | 32-bit unsigned integer | See Appendix D |
| num_satgeoqa | 16-bit integer | Number of scans with problems in satgeoqa |
| num_glintgeoqa | 16-bit integer | Number of scans with problems in glintgeoqa |
| num_moongeoqa | 16-bit integer | Number of scans with problems in moongeoqa |
| num_ftptgeoqa | 16-bit integer | Number of footprints with problems in ftptgeoqa |
| num_zengeoqa | 16-bit integer | Number of footprints with problems in zengeoqa |
| num_demgeoqa | 16-bit integer | Number of footprints with problems in demgeoqa |
| num_fpe | 16-bit integer | Number of floating point errors |
| LonGranuleCen | 16-bit integer | Geodetic Longitude of the center of the granule in degrees East (-180 ... 180) |
| LatGranuleCen | 16-bit integer | Geodetic Latitude of the center of the granule in degrees North (-90 ... 90) |
| LocTimeGranuleCen | 16-bit integer | Local solar time at the center of the granule in minutes past midnight (0 ... 1439) |
| VegMapFileName | string of 8-bit characters | Name of AVHRR input file used as Vegetation Map |
| limit_vis_det_temp | Color Counts (see below) | Input limit checking on Vis sensor array temperature |
| input_vis_det_temp | Limited Engineering Struct (see below) | Input statistics on Vis sensor array temperature |
| granules_present | string of 8-bit characters | Zero-terminated character string denoting which adjacent granules were available for smoothing ("All" for both previous & next, "Prev" for previous but not next, "Next" for next but not previous, "None" for neither previous nor next) |
| align_1_2_nadir | 32-bit floating-point | Expected error (km) between the pixel locations for the corner locations of near-nadir AIRS footprints (45 & 46) between VIS channels 1 & 2 |
| align_2_3_nadir | 32-bit floating-point | Expected error (km) between the pixel locations for the corner locations of near-nadir AIRS footprints (45 & 46) between VIS channels 2 & 3 |
| align_2_4_nadir | 32-bit floating-point | Expected error (km) between the pixel locations for the corner locations of near-nadir AIRS footprints (45 & 46) between VIS channels 2 & 4 |
| align_1_2_maxang | 32-bit floating-point | Expected error (km) between the pixel locations for the corner locations of near-limb AIRS footprints (1 & 90) between VIS channels 1 & 2 |
| align_2_3_maxang | 32-bit floating-point | Expected error (km) between the pixel locations for the corner locations of near-limb AIRS footprints (1 & 90) between VIS channels 2 & 3 |
| align_2_4_maxang | 32-bit floating-point | Expected error (km) between the pixel locations for the corner locations of near-limb AIRS footprints (1 & 90) between VIS channels 2 & 4 |
| align_vis_airs | 32-bit floating-point | Expected error (km) between the pixel locations for the corner locations of near-nadir AIRS footprints (45 & 46) between the AIRS center and all VIS channels |

## Per-Granule Data Fields

These fields appear only once per granule and use the HDF-EOS "Field" interface.

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| limit_scene_counts | Color Counts (see below) | Channel (= 4) * SubTrack (= 9) | Input limit checking on scene data numbers |
| limit_bb_counts | Color Counts (see below) | Channel (= 4) * SubTrack (= 9) | Input limit checking on data numbers from the blackbody (dark target) |
| limit_phot_counts | Color Counts (see below) | Channel (= 4) * SubTrack (= 9) | Input limit checking on data numbers from the photometric calibration source (bright target) |

| | | | |
|---|---|---|---|
| input_scene_counts | Limited Engineering Struct (see below) | Channel (= 4) * SubTrack (= 9) | Input statistics on scene data numbers |
| input_bb_counts | Limited Engineering Struct (see below) | Channel (= 4) * SubTrack (= 9) | Input statistics on data numbers from the blackbody (dark target) |
| input_phot_counts | Limited Engineering Struct (see below) | Channel (= 4) * SubTrack (= 9) | Input statistics on data numbers from the photometric calibration source (bright target) |
| limit_offsets | Color Counts (see below) | Channel (= 4) * SubTrack (= 9) | Output limit checking on offsets |
| offset_stats | Unlimited Engineering Struct (see below) | Channel (= 4) * SubTrack (= 9) | Statistics on offsets |
| offset_unc_stats | Unlimited Engineering Struct (see below) | Channel (= 4) * SubTrack (= 9) | Statistics on offset uncertainties |
| gain | 32-bit floating-point | Channel (= 4) * SubTrack (= 9) | Gain: number of radiance units per count. |
| gain_err | 32-bit floating-point | Channel (= 4) * SubTrack (= 9) | Error caused by imperfect fit for gain (gain units). |
| rad_stats | Unlimited Engineering Struct (see below) | Channel (= 4) * SubTrack (= 9) | Statistics over the granule of radiances (radiance units) |
| NeN_stats | Limited Engineering Struct (see below) | Channel (= 4) * SubTrack (= 9) | Statistics over the granule of Noise-equivalent Radiance (NeN) |
| xtrack_err | 32-bit floating-point | Channel (= 4) | cross-track pixel location error estimate per channel (km) |
| track_err | 32-bit floating-point | Channel (= 4) | Along-track pixel location error estimate per channel (km) |

## Along-Track Data Fields

These fields appear once per scanline (GeoTrack times).

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| offset | 32-bit floating-point | Channel (= 4) * SubTrack (= 9) | Offset: number of counts expected for no radiance at time nadirTAI |
| offset_err | 32-bit floating-point | Channel (= 4) * SubTrack (= 9) | Error caused by imperfect fit for offset (radiance units) |
| NeN | 32-bit floating-point | Channel (= 4) * SubTrack (= 9) | Noise-equivalent Radiance (radiance units) |
| satheight | 32-bit floating-point | None | Satellite altitude at nadirTAI in km above reference ellipsoid (e.g. 725.2) |
| satroll | 32-bit floating-point | None | Satellite attitude roll angle at nadirTAI (-180.0 ... 180.0 angle about the +x (roll) ORB axis, +x axis is positively oriented in the direction of orbital flight completing an orthogonal triad with y and z.) |
| satpitch | 32-bit floating-point | None | Satellite attitude pitch angle at nadirTAI (-180.0 ... 180.0 angle about +y (pitch) ORB axis. +y axis is oriented normal to the orbit plane with the positive sense opposite to that of the orbit's angular momentum vector H.) |
| satyaw | 32-bit floating-point | None | Satellite attitude yaw angle at nadirTAI (-180.0 ... 180.0 angle about +z (yaw) axis. +z axis is positively oriented Earthward parallel to the satellite radius vector R from the spacecraft center of mass to the center of the Earth.) |
| satgeoqa | 32-bit unsigned integer | None | See Appendix D |
| glintgeoqa | 16-bit unsigned integer | None | See Appendix D |
| moongeoqa | 16-bit unsigned integer | None | See Appendix D |
| nadirTAI | 64-bit floating-point | None | TAI time at which instrument is nominally looking directly down. (between footprints 15 & 16 for AMSU or between footprints 45 & 46 for AIRS/Vis & HSB) (floating-point elapsed seconds since start of 1993) |
| sat_lat | 64-bit floating-point | None | Satellite geodetic latitude in degrees North (-90.0 ... 90.0) |

| | | | |
|---|---|---|---|
| sat_lon | 64-bit floating-point | None | Satellite geodetic longitude in degrees East (-180.0 ... 180.0) |
| scan_node_type | 8-bit integer | None | 'A' for ascending, 'D' for descending, 'E' when an error is encountered in trying to determine a value. |
| glintlat | 32-bit floating-point | None | Solar glint geodetic latitude in degrees North at nadirTAI (-90.0 ... 90.0) |
| glintlon | 32-bit floating-point | None | Solar glint geodetic longitude in degrees East at nadirTAI (-180.0 ... 180.0) |
| ViSnsrArrTemp | 32-bit floating-point | None | Vis/NIR Sensor Array Temperature (Celcius) |
| ScHeadTemp1 | 32-bit floating-point | None | Scanner Head Housing Temperature 1 (active A or B) (Celcius) |
| OpMode | 16-bit unsigned integer | None | Instrument Operations Mode. See AIRS Command Handbook, section 6.4 for a definition of each bit. Bits 0 (LSB)-2 cal phase;<br>bits 3-6 Cal Func;<br>Bit 7 quicklook (expedited) flag;<br>bits 8-11 submode Bits 12-14 Mode (0=standby, 1=ready, 2=operate, 3=checkout, 4=decontaminate, 5=off, 6=survival);<br>bit 16 transition flag |

## Full Swath Data Fields

These fields appear for every footprint of every scanline in the granule (GeoTrack * GeoXTrack times).

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| radiances | 32-bit floating-point | Channel (= 4) * SubTrack (= 9) * SubXTrack (= 8) | Radiances for each channel in Watts/m**2/micron/steradian |
| PrelimCldQA | 8-bit integer | None | Cloud QA index (0-good or 1-bad) -1 for not calculated |
| PrelimCldFracVis | 32-bit floating-point | None | Cloud Fraction (0.0-1.0) -9999.0 for not calculated |
| PrelimCldFracVisErr | 32-bit floating-point | None | Cloud Fraction Error (0.0-1.0) -9999.0 for not calculated |
| PrelimClrFracVis | 32-bit floating-point | None | Clear Fraction (0.0-1.0) -9999.0 for not calculated |
| PrelimClrFracVisErr | 32-bit floating-point | None | Clear Fraction Error (0.0-1.0) -9999.0 for not calculated |
| PrelimCldMapVis | 8-bit integer | SubTrack (= 9) * SubXTrack (= 8) | Cloud Map (0-clear, 1-cloudy) -1 for not calculated |
| PrelimNDVI | 32-bit floating-point | SubTrack (= 9) * SubXTrack (= 8) | Vegetation Index (-1.0 to 1.0) -999.0 for not calculated |
| bright_index | 16-bit integer | None | Brightness index (1...5, 5 is brightest. -1 for not calculated |
| inhomo_index | 16-bit integer | None | Inhomgeneity index (0...64, 1st digit NDVI-Dev, 2nd digit Ch1-Dev, -9999 for not calculated |
| scanang | 32-bit floating-point | None | Scanning angle of AIRS instrument with respect to the AIRS Instrument for this footprint (-180.0 ... 180.0, negative at start of scan, 0 at nadir) |
| ftptgeoqa | 32-bit unsigned integer | None | See Appendix D |
| zengeoqa | 16-bit unsigned integer | None | See Appendix D |
| demgeoqa | 16-bit unsigned integer | None | See Appendix D |

| | | | |
|---|---|---|---|
| satzen | 32-bit floating-point | None | Spacecraft zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| satazi | 32-bit floating-point | None | Spacecraft azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| solzen | 32-bit floating-point | None | Solar zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| solazi | 32-bit floating-point | None | Solar azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| sun_glint_distance | 16-bit integer | None | Distance (km) from footprint center to location of the sun glint (-9999 for unknown, 30000 for no glint visible because spacecraft is in Earth's shadow) |
| topog | 32-bit floating-point | None | Mean topography in meters above reference ellipsoid |
| topog_err | 32-bit floating-point | None | Error estimate for topog |
| landFrac | 32-bit floating-point | None | Fraction of spot that is land (0.0 ... 1.0) |
| landFrac_err | 32-bit floating-point | None | Error estimate for landFrac |
| state | 32-bit integer | None | Data state: 0:Process, 1:Special, 2:Erroneous, 3:Missing |
| cornerlats | 32-bit floating-point | GeoLocationsPerSpot (= 4) * Channel (= 4) | Geodetic Latitudes at the centers of the pixels at the corners of the IR footprint by channel in degrees North (-90.0 ... 90.0) |
| cornerlons | 32-bit floating-point | GeoLocationsPerSpot (= 4) * Channel (= 4) | Geodetic Longitudes at the centers of the pixels at the corners of the IR footprint by channel in degrees East (-180.0 ... 180.0) |

## Special AIRS Types

AIRS works around the lack of support for records in HDF-EOS Swath by grouping related fields into pseudo-records. HDF-EOS fieldnames are generated by concatenating the pseudo-record name with the subfield name, putting a "." character in between. Since these record types do not exist at the HDF-EOS swath level, reading subfield "min" of AIRS field "input_scene_counts" involves reading HDF-EOS Swath field "input_scene_counts.min".

Limited Engineering Struct: This type is used for engineering data fields for which there are known "yellow" limits.

| Field Name | Type | Explanation |
|---|---|---|
| min | 32-bit floating-point | Minimum value field takes on in granule (not valid when num_in = 0) |
| max | 32-bit floating-point | Maximum value field takes on in granule (not valid when num_in = 0) |
| mean | 32-bit floating-point | Mean of values field takes on in granule (not valid when num_in = 0) |
| dev | 32-bit floating-point | Standard Deviation of values field takes on in granule (not valid when num_in < 2) |
| num_in | 32-bit integer | Count of in-range values field takes on in granule |
| num_lo | 32-bit integer | Count of out-of-range low values field takes on in granule |
| num_hi | 32-bit integer | Count of out-of-range high values field takes on in granule |
| num_bad | 32-bit integer | Count of occassions on which field takes on invalid flag value (-9999) in granule |

| | | |
|---|---|---|
| range_min | 32-bit floating-point | Minimum in-range value. |
| range_max | 32-bit floating-point | Maximum in-range value. |
| missing | 8-bit integer | Missing limits flags. Bit 0 (LSB) is 1 when yellow low (range_min) limit is missing;<br>Bit 1 is high when yellow high (range_max) limit is missing;<br>other bits unused, set to 0. |
| max_track | 32-bit integer | GeoTrack index (counting from 1) where max was found |
| max_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where max was found |
| min_track | 32-bit integer | GeoTrack index (counting from 1) where min was found |
| min_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where min was found |

Unlimited Engineering Struct: This type is used for engineering data fields for which there are NOT known "yellow" limits.

| Field Name | Type | Explanation |
|---|---|---|
| min | 32-bit floating-point | Minimum value field takes on in granule (not valid when num = 0) |
| max | 32-bit floating-point | Maximum value field takes on in granule (not valid when num = 0) |
| mean | 32-bit floating-point | Mean of values field takes on in granule (not valid when num = 0) |
| dev | 32-bit floating-point | Standard Deviation of values field takes on in granule (not valid when num < 2) |
| num | 32-bit integer | Count of occurrences of field in granule (not including those counted in num_bad) |
| num_bad | 32-bit integer | Count of occassions on which field takes on invalid flag value (-9999) in granule |
| max_track | 32-bit integer | GeoTrack index (counting from 1) where max was found |
| max_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where max was found |
| min_track | 32-bit integer | GeoTrack index (counting from 1) where min was found |
| min_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where min was found |

Color Counts: This type tracks counts of values received during an interval by how they compare to corresponding "red" and "yellow" limits.

| Field Name | Type | Explanation |
|---|---|---|
| red_lo_limit | 32-bit floating-point | Value of the low "red" limit. |
| red_lo_cnt | 32-bit integer | Count of values less than the low "red" limit. This is an "Alarm" condition. |
| to_red_lo | 32-bit integer | Count of occasions on which the "color" of this field changed from some other value to "red_low". |
| yellow_lo_limit | 32-bit floating-point | Value of the low "yellow" limit. |
| yellow_lo_cnt | 32-bit integer | Count of values greater than the low "red" limit but less than the low "yellow" limit. This is a "Warning" condition. |
| to_yellow_lo | 32-bit integer | Count of occasions on which the "color" of this field changed from some other value to "yellow_low". |
| green_cnt | 32-bit integer | Count of values greater than the low "yellow" limit but less than the high "yellow" limit. |
| to_green | 32-bit integer | Count of occasions on which the "color" of this field changed from some other value to "green". |
| yellow_hi_limit | 32-bit floating-point | Value of the high "yellow" limit. |
| yellow_hi_cnt | 32-bit integer | Count of values greater than the high "yellow" limit but less than the high "red" limit. This is a "Warning" condition. |
| to_yellow_hi | 32-bit integer | Count of occasions on which the "color" of this field changed from some other value to "yellow_high". |
| red_hi_limit | 32-bit floating-point | Value of the high "red" limit. |
| red_hi_cnt | 32-bit integer | Count of values greater than the high "red" limit. This is an "Alarm" condition. |

| | | |
|---|---|---|
| to_red_hi | 32-bit integer | Count of occasions on which the "color" of this field changed from some other value to "red_high". |
| missing | 8-bit integer | Missing limits flags. Bit 0 (LSB) is 1 when yellow low limit (yellow_lo_limit) is missing;<br>Bit 1 is high when yellow high limit is missing;<br>Bit 2 is 1 when red low limit is missing;<br>Bit 3 is 1 when red high limit is missing;<br>Other bits unused set to 0. |

# A1-4. L1B Visible/NIR QA Interface Specification

Interface Specification Version 5.0.14.0
2007-04-11

ESDT ShortName = "AIRVBQAP"

Swath Name = "L1B_VIS_QA"

Level = "level1B"

# Footprints = 90

# scanlines per scanset = 3

## Dimensions

These fields define all dimensions that can be used for HDF-EOS swath fields.

The names "GeoTrack" and "GeoXTrack" have a special meaning for this document: "Cross-Track" data fields have a hidden dimension of "GeoXTrack"; "Along-Track" data fields have a hidden dimension of "GeoTrack"; "Full Swath" data fields have hidden dimensions of both "GeoTrack" and "GeoXTrack".

| Name | Value | Explanation |
|---|---|---|
| GeoXTrack | 90 | Dimension across track for footprint positions. Same as number of footprints per scanline. -- starting at the left and increasing towards the right as you look along the satellite's path |
| GeoTrack | # of scan lines in swath | Dimension along track for footprint positions. Same as number of scanlines in granule. Parallel to the satellite's path, increasing with time. (Nominally 45 for Level-2, AMSU-A, and AIRS/Vis low-rate engineering;<br>135 for AIRS/Vis and HSB high-rate quantities) |
| SubTrack | 9 | VIS detector elements per AIRS footprint along track (9). Direction is the same as GeoTrack -- parallel to the satellite's path, increasing with time. (opposite order to detector ordering -- detector 0 is last) |
| SubXTrack | 8 | VIS samples per AIRS footprint across track (8). Direction is the same as GeoXTrack -- starting at the left and increasing towards the right as you look along the satellite's path |
| GeoLocationsPerSpot | 4 | Geolocations for the 4 corner pixels in the order: trailing first scanned;<br>trailing last-scanned;<br>leading first-scanned;<br>leading last-scanned. Each footprint also has a central geolocation associated with the swath geolocation lat/lon/time of the footprint. |
| Channel | 4 | Dimension of channel array (Channel 1: ~0.40 micron;<br>Ch 2: ~0.6 micron;<br>Ch 3: ~0.8 micron;<br>Ch 4: broadband) |

## Geolocation Fields

These fields appear for every footprint (GeoTrack * GeoXTrack times) and correspond to footprint center coordinates and "shutter" time.

| Name | Explanation |
|---|---|
| Latitude | Footprint boresight geodetic Latitude in degrees North (-90.0 ... 90.0) |
| Longitude | Footprint boresight geodetic Longitude in degrees East (-180.0 ... 180.0) |
| Time | Footprint "shutter" TAI Time: floating-point elapsed seconds since Jan 1, 1993 |

## Attributes

These fields appear only once per granule and use the HDF-EOS "Attribute" interface.

| Name | Type | Explanation |
|---|---|---|
| processing_level | string of 8-bit characters | Zero-terminated character string denoting processing level ("level1B") |
| instrument | string of 8-bit characters | Zero-terminated character string denoting instrument ("VIS") |
| DayNightFlag | string of 8-bit characters | Zero-terminated character string set to "Night" when the subsatellite points at the beginning and end of a granule are both experiencing night according to the "civil twilight" standard (center of refracted sun is below the horizon). It is set to "Day" when both are experiencing day, and "Both" when one is experiencing day and the other night. "NA" is used when a determination cannot be made. |
| AutomaticQAFlag | string of 8-bit characters | Zero-terminated character string denoting granule data quality: (Always "Passed", "Failed", or "Suspect") |
| NumTotalData | 32-bit integer | Total number of expected scene footprints |
| NumProcessData | 32-bit integer | Number of scene footprints which are present and can be processed routinely (state = 0) |
| NumSpecialData | 32-bit integer | Number of scene footprints which are present and can be processed only as a special test (state = 1) |
| NumBadData | 32-bit integer | Number of scene footprints which are present but cannot be processed (state = 2) |
| NumMissingData | 32-bit integer | Number of expected scene footprints which are not present (state = 3) |
| NumLandSurface | 32-bit integer | Number of scene footprints for which the surface is more than 90% land |
| NumOceanSurface | 32-bit integer | Number of scene footprints for which the surface is less than 10% land |
| node_type | string of 8-bit characters | Zero-terminated character string denoting whether granule is ascending, descending, or pole-crossing: ("Ascending" and "Descending" for entirely ascending or entirely descending granules, or "NorthPole" or "SouthPole" for pole-crossing granules. "NA" when determination cannot be made.) |
| start_year | 32-bit integer | Year in which granule started, UTC (e.g. 1999) |
| start_month | 32-bit integer | Month in which granule started, UTC (1 ... 12) |
| start_day | 32-bit integer | Day of month in which granule started, UTC (1 ... 31) |
| start_hour | 32-bit integer | Hour of day in which granule started, UTC (0 ... 23) |
| start_minute | 32-bit integer | Minute of hour in which granule started, UTC (0 ... 59) |
| start_sec | 32-bit floating-point | Second of minute in which granule started, UTC (0.0 ... 59.0) |
| start_orbit | 32-bit integer | Orbit number of mission in which granule started |
| end_orbit | 32-bit integer | Orbit number of mission in which granule ended |
| orbit_path | 32-bit integer | Orbit path of start orbit (1 ... 233 as defined by EOS project) |
| start_orbit_row | 32-bit integer | Orbit row at start of granule (1 ... 248 as defined by EOS project) |
| end_orbit_row | 32-bit integer | Orbit row at end of granule (1 ... 248 as defined by EOS project) |
| granule_number | 32-bit integer | Number of granule within day (1 ... 240) |
| num_scansets | 32-bit integer | Number of scansets in granule (1 ... 45) |
| num_scanlines | 32-bit integer | Number of scanlines in granule (3 * num_scansets) |
| start_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees North (-90.0 ... 90.0) |
| start_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees East (-180.0 ... 180.0) |
| start_Time | 64-bit floating-point | TAI Time at start of granule (floating-point elapsed seconds since start of 1993) |
| end_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees North (-90.0 ... 90.0) |
| end_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees East (-180.0 ... 180.0) |
| end_Time | 64-bit floating-point | TAI Time at end of granule (floating-point elapsed seconds since start of 1993) |

| | | |
|---|---|---|
| eq_x_longitude | 32-bit floating-point | Longitude of spacecraft at southward equator crossing nearest granule start in degrees East (-180.0 ... 180.0) |
| eq_x_tai | 64-bit floating-point | Time of eq_x_longitude in TAI units (floating-point elapsed seconds since start of 1993) |
| orbitgeoqa | 32-bit unsigned integer | See Appendix D |
| num_satgeoqa | 16-bit integer | Number of scans with problems in satgeoqa |
| num_glintgeoqa | 16-bit integer | Number of scans with problems in glintgeoqa |
| num_moongeoqa | 16-bit integer | Number of scans with problems in moongeoqa |
| num_ftptgeoqa | 16-bit integer | Number of footprints with problems in ftptgeoqa |
| num_zengeoqa | 16-bit integer | Number of footprints with problems in zengeoqa |
| num_demgeoqa | 16-bit integer | Number of footprints with problems in demgeoqa |
| num_fpe | 16-bit integer | Number of floating point errors |
| LonGranuleCen | 16-bit integer | Geodetic Longitude of the center of the granule in degrees East (-180 ... 180) |
| LatGranuleCen | 16-bit integer | Geodetic Latitude of the center of the granule in degrees North (-90 ... 90) |
| LocTimeGranuleCen | 16-bit integer | Local solar time at the center of the granule in minutes past midnight (0 ... 1439) |
| VegMapFileName | string of 8-bit characters | Name of AVHRR input file used as Vegetation Map |
| limit_vis_det_temp | Color Counts (see below) | Input limit checking on Vis sensor array temperature |
| input_vis_det_temp | Limited Engineering Struct (see below) | Input statistics on Vis sensor array temperature |
| granules_present | string of 8-bit characters | Zero-terminated character string denoting which adjacent granules were available for smoothing ("All" for both previous & next, "Prev" for previous but not next, "Next" for next but not previous, "None" for neither previous nor next) |
| align_1_2_nadir | 32-bit floating-point | Expected error (km) between the pixel locations for the corner locations of near-nadir AIRS footprints (45 & 46) between VIS channels 1 & 2 |
| align_2_3_nadir | 32-bit floating-point | Expected error (km) between the pixel locations for the corner locations of near-nadir AIRS footprints (45 & 46) between VIS channels 2 & 3 |
| align_2_4_nadir | 32-bit floating-point | Expected error (km) between the pixel locations for the corner locations of near-nadir AIRS footprints (45 & 46) between VIS channels 2 & 4 |
| align_1_2_maxang | 32-bit floating-point | Expected error (km) between the pixel locations for the corner locations of near-limb AIRS footprints (1 & 90) between VIS channels 1 & 2 |
| align_2_3_maxang | 32-bit floating-point | Expected error (km) between the pixel locations for the corner locations of near-limb AIRS footprints (1 & 90) between VIS channels 2 & 3 |
| align_2_4_maxang | 32-bit floating-point | Expected error (km) between the pixel locations for the corner locations of near-limb AIRS footprints (1 & 90) between VIS channels 2 & 4 |
| align_vis_airs | 32-bit floating-point | Expected error (km) between the pixel locations for the corner locations of near-nadir AIRS footprints (45 & 46) between the AIRS center and all VIS channels |

## Per-Granule Data Fields

These fields appear only once per granule and use the HDF-EOS "Field" interface.

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| limit_scene_counts | Color Counts (see below) | Channel (= 4) * SubTrack (= 9) | Input limit checking on scene data numbers |
| limit_bb_counts | Color Counts (see below) | Channel (= 4) * SubTrack (= 9) | Input limit checking on data numbers from the blackbody (dark target) |
| limit_phot_counts | Color Counts (see below) | Channel (= 4) * SubTrack (= 9) | Input limit checking on data numbers from the photometric calibration source (bright target) |
| input_scene_counts | Limited Engineering Struct (see below) | Channel (= 4) * SubTrack (= 9) | Input statistics on scene data numbers |
| input_bb_counts | Limited Engineering Struct (see below) | Channel (= 4) * SubTrack (= 9) | Input statistics on data numbers from the blackbody (dark target) |
| input_phot_counts | Limited Engineering Struct | Channel (= 4) * | Input statistics on data numbers from the photometric |

| | | | |
|---|---|---|---|
| | (see below) | SubTrack (= 9) | calibration source (bright target) |
| limit_offsets | Color Counts (see below) | Channel (= 4) * SubTrack (= 9) | Output limit checking on offsets |
| offset_stats | Unlimited Engineering Struct (see below) | Channel (= 4) * SubTrack (= 9) | Statistics on offsets |
| offset_unc_stats | Unlimited Engineering Struct (see below) | Channel (= 4) * SubTrack (= 9) | Statistics on offset uncertainties |
| gain | 32-bit floating-point | Channel (= 4) * SubTrack (= 9) | Gain: number of radiance units per count. |
| gain_err | 32-bit floating-point | Channel (= 4) * SubTrack (= 9) | Error caused by imperfect fit for gain (gain units). |
| rad_stats | Unlimited Engineering Struct (see below) | Channel (= 4) * SubTrack (= 9) | Statistics over the granule of radiances (radiance units) |
| NeN_stats | Limited Engineering Struct (see below) | Channel (= 4) * SubTrack (= 9) | Statistics over the granule of Noise-equivalent Radiance (NeN) |
| xtrack_err | 32-bit floating-point | Channel (= 4) | cross-track pixel location error estimate per channel (km) |
| track_err | 32-bit floating-point | Channel (= 4) | Along-track pixel location error estimate per channel (km) |

## Along-Track Data Fields

These fields appear once per scanline (GeoTrack times).

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| satheight | 32-bit floating-point | None | Satellite altitude at nadirTAI in km above reference ellipsoid (e.g. 725.2) |
| satroll | 32-bit floating-point | None | Satellite attitude roll angle at nadirTAI (-180.0 ... 180.0 angle about the +x (roll) ORB axis, +x axis is positively oriented in the direction of orbital flight completing an orthogonal triad with y and z.) |
| satpitch | 32-bit floating-point | None | Satellite attitude pitch angle at nadirTAI (-180.0 ... 180.0 angle about +y (pitch) ORB axis. +y axis is oriented normal to the orbit plane with the positive sense opposite to that of the orbit's angular momentum vector H.) |
| satyaw | 32-bit floating-point | None | Satellite attitude yaw angle at nadirTAI (-180.0 ... 180.0 angle about +z (yaw) axis. +z axis is positively oriented Earthward parallel to the satellite radius vector R from the spacecraft center of mass to the center of the Earth.) |
| satgeoqa | 32-bit unsigned integer | None | See Appendix D |
| glintgeoqa | 16-bit unsigned integer | None | See Appendix D |
| moongeoqa | 16-bit unsigned integer | None | See Appendix D |
| nadirTAI | 64-bit floating-point | None | TAI time at which instrument is nominally looking directly down. (between footprints 15 & 16 for AMSU or between footprints 45 & 46 for AIRS/Vis & HSB) (floating-point elapsed seconds since start of 1993) |
| sat_lat | 64-bit floating-point | None | Satellite geodetic latitude in degrees North (-90.0 ... 90.0) |
| sat_lon | 64-bit floating-point | None | Satellite geodetic longitude in degrees East (-180.0 ... 180.0) |
| scan_node_type | 8-bit integer | None | 'A' for ascending, 'D' for descending, 'E' when an error is encountered in trying to determine a value. |
| glintlat | 32-bit floating-point | None | Solar glint geodetic latitude in degrees North at nadirTAI (-90.0 ... 90.0) |
| glintlon | 32-bit floating-point | None | Solar glint geodetic longitude in degrees East at nadirTAI (-180.0 ... 180.0) |
| ViSnsrArrTemp | 32-bit floating-point | None | Vis/NIR Sensor Array Temperature (Celcius) |

| | | | |
|---|---|---|---|
| ScHeadTemp1 | 32-bit floating-point | None | Scanner Head Housing Temperature 1 (active A or B) (Celcius) |
| OpMode | 16-bit unsigned integer | None | Instrument Operations Mode. See AIRS Command Handbook, section 6.4 for a definition of each bit. Bits 0 (LSB)-2 cal phase;<br>bits 3-6 Cal Func;<br>Bit 7 quicklook (expedited) flag;<br>bits 8-11 submode Bits 12-14 Mode (0=standby, 1=ready, 2=operate, 3=checkout, 4=decontaminate, 5=off, 6=survival);<br>bit 16 transition flag |

## Full Swath Data Fields

These fields appear for every footprint of every scanline in the granule (GeoTrack * GeoXTrack times).

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| scanang | 32-bit floating-point | None | Scanning angle of AIRS instrument with respect to the AIRS Instrument for this footprint (-180.0 ... 180.0, negative at start of scan, 0 at nadir) |
| ftptgeoqa | 32-bit unsigned integer | None | See Appendix D |
| zengeoqa | 16-bit unsigned integer | None | See Appendix D |
| demgeoqa | 16-bit unsigned integer | None | See Appendix D |
| satzen | 32-bit floating-point | None | Spacecraft zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| satazi | 32-bit floating-point | None | Spacecraft azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| solzen | 32-bit floating-point | None | Solar zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| solazi | 32-bit floating-point | None | Solar azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| sun_glint_distance | 16-bit integer | None | Distance (km) from footprint center to location of the sun glint (-9999 for unknown, 30000 for no glint visible because spacecraft is in Earth's shadow) |
| topog | 32-bit floating-point | None | Mean topography in meters above reference ellipsoid |
| topog_err | 32-bit floating-point | None | Error estimate for topog |
| landFrac | 32-bit floating-point | None | Fraction of spot that is land (0.0 ... 1.0) |
| landFrac_err | 32-bit floating-point | None | Error estimate for landFrac |
| state | 32-bit integer | None | Data state: 0:Process, 1:Special, 2:Erroneous, 3:Missing |

## Special AIRS Types

AIRS works around the lack of support for records in HDF-EOS Swath by grouping related fields into pseudo-records. HDF-EOS fieldnames are generated by concatenating the pseudo-record name with the subfield name, putting a "." character in between. Since these record types do not exist at the HDF-EOS swath level, reading subfield "min" of AIRS field "input_scene_counts" involves reading HDF-EOS Swath field "input_scene_counts.min".

Limited Engineering Struct: This type is used for engineering data fields for which there are known "yellow" limits.

| Field Name | Type | Explanation |
|---|---|---|
| min | 32-bit floating-point | Minimum value field takes on in granule (not valid when num_in = 0) |
| max | 32-bit floating-point | Maximum value field takes on in granule (not valid when num_in = 0) |

| | | |
|---|---|---|
| mean | 32-bit floating-point | Mean of values field takes on in granule (not valid when num_in = 0) |
| dev | 32-bit floating-point | Standard Deviation of values field takes on in granule (not valid when num_in < 2) |
| num_in | 32-bit integer | Count of in-range values field takes on in granule |
| num_lo | 32-bit integer | Count of out-of-range low values field takes on in granule |
| num_hi | 32-bit integer | Count of out-of-range high values field takes on in granule |
| num_bad | 32-bit integer | Count of occassions on which field takes on invalid flag value (-9999) in granule |
| range_min | 32-bit floating-point | Minimum in-range value. |
| range_max | 32-bit floating-point | Maximum in-range value. |
| missing | 8-bit integer | Missing limits flags. Bit 0 (LSB) is 1 when yellow low (range_min) limit is missing;<br>Bit 1 is high when yellow high (range_max) limit is missing;<br>other bits unused, set to 0. |
| max_track | 32-bit integer | GeoTrack index (counting from 1) where max was found |
| max_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where max was found |
| min_track | 32-bit integer | GeoTrack index (counting from 1) where min was found |
| min_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where min was found |

Unlimited Engineering Struct: This type is used for engineering data fields for which there are NOT known "yellow" limits.

| Field Name | Type | Explanation |
|---|---|---|
| min | 32-bit floating-point | Minimum value field takes on in granule (not valid when num = 0) |
| max | 32-bit floating-point | Maximum value field takes on in granule (not valid when num = 0) |
| mean | 32-bit floating-point | Mean of values field takes on in granule (not valid when num = 0) |
| dev | 32-bit floating-point | Standard Deviation of values field takes on in granule (not valid when num < 2) |
| num | 32-bit integer | Count of occurrences of field in granule (not including those counted in num_bad) |
| num_bad | 32-bit integer | Count of occassions on which field takes on invalid flag value (-9999) in granule |
| max_track | 32-bit integer | GeoTrack index (counting from 1) where max was found |
| max_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where max was found |
| min_track | 32-bit integer | GeoTrack index (counting from 1) where min was found |
| min_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where min was found |

Color Counts: This type tracks counts of values received during an interval by how they compare to corresponding "red" and "yellow" limits.

| Field Name | Type | Explanation |
|---|---|---|
| red_lo_limit | 32-bit floating-point | Value of the low "red" limit. |
| red_lo_cnt | 32-bit integer | Count of values less than the low "red" limit. This is an "Alarm" condition. |
| to_red_lo | 32-bit integer | Count of occasions on which the "color" of this field changed from some other value to "red_low". |
| yellow_lo_limit | 32-bit floating-point | Value of the low "yellow" limit. |
| yellow_lo_cnt | 32-bit integer | Count of values greater than the low "red" limit but less than the low "yellow" limit. This is a "Warning" condition. |
| to_yellow_lo | 32-bit integer | Count of occasions on which the "color" of this field changed from some other value to "yellow_low". |
| green_cnt | 32-bit integer | Count of values greater than the low "yellow" limit but less than the high "yellow" limit. |
| to_green | 32-bit integer | Count of occasions on which the "color" of this field changed from some other value to "green". |
| yellow_hi_limit | 32-bit floating-point | Value of the high "yellow" limit. |
| yellow_hi_cnt | 32-bit integer | Count of values greater than the high "yellow" limit but less than the high "red" limit. This is a "Warning" condition. |
| to_yellow_hi | 32-bit integer | Count of occasions on which the "color" of this field changed from some other value to |

| | | |
|---|---|---|
| | | "yellow_high". |
| red_hi_limit | 32-bit floating-point | Value of the high "red" limit. |
| red_hi_cnt | 32-bit integer | Count of values greater than the high "red" limit. This is an "Alarm" condition. |
| to_red_hi | 32-bit integer | Count of occasions on which the "color" of this field changed from some other value to "red_high". |
| missing | 8-bit integer | Missing limits flags. Bit 0 (LSB) is 1 when yellow low limit (yellow_lo_limit) is missing;<br>Bit 1 is high when yellow high limit is missing;<br>Bit 2 is 1 when red low limit is missing;<br>Bit 3 is 1 when red high limit is missing;<br>Other bits unused set to 0. |

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# A1-5. L1B AMSU Interface Specification

Interface Specification Version 5.0.14.0
2007-04-11

ESDT ShortName = "AIRABRAD"

Swath Name = "L1B_AMSU"

Level = "level1B"

# Footprints = 30

# scanlines per scanset = 1

## Dimensions

These fields define all dimensions that can be used for HDF-EOS swath fields.

The names "GeoTrack" and "GeoXTrack" have a special meaning for this document: "Cross-Track" data fields have a hidden dimension of "GeoXTrack"; "Along-Track" data fields have a hidden dimension of "GeoTrack"; "Full Swath" data fields have hidden dimensions of both "GeoTrack" and "GeoXTrack".

| Name | Value | Explanation |
|---|---|---|
| GeoXTrack | 30 | Dimension across track for footprint positions. Same as number of footprints per scanline. -- starting at the left and increasing towards the right as you look along the satellite's path |
| GeoTrack | # of scan lines in swath | Dimension along track for footprint positions. Same as number of scanlines in granule. Parallel to the satellite's path, increasing with time. (Nominally 45 for Level-2, AMSU-A, and AIRS/Vis low-rate engineering;<br>135 for AIRS/Vis and HSB high-rate quantities) |
| Channel | 15 | Dimension of channel array (Channel 1: 23.8 GHz;<br>Ch 2: 31.4 GHz;<br>Ch 3: 50.3 GHz;<br>Ch 4: 52.8 GHz;<br>Ch 5: 53.596 +/- 0.115 GHz;<br>Ch 6: 54.4 GHz;<br>Ch 7: 54.94 GHz;<br>Ch 8: 55.5 GHz;<br>Ch 9: f0;<br>Ch 10: f0 +/- 0.217 GHz Ch 11: f0 +/- df +/- 48 MHz;<br>Ch 12: f0 +/- df +/- 22 MHz;<br>Ch 13: f0 +/- df +/- 10 MHz;<br>Ch 14: f0 +/- df +/- 4.5 MHz;<br>Ch 15: 89 GHz (f0 = 57290.344 MHz;<br>df = 322.4 MHz)) |
| CalXTrack | 4 | Dimension "across" track for calibration footprint positions. Same as number of calibration footprints per scanline. (NUM_FOOTPRINTS_AMSU_CALIB) (Footprints are ordered: 1-2: spaceviews;<br>3-4: blackbody radiometric calibration source) |
| SpaceXTrack | 2 | Dimension "across" track for spaceview calibration footprint positions in order of observation time. (NUM_FOOTPRINTS_AMSU_SPACE) |
| BBXTrack | 2 | Dimension "across" track for blackbody calibration footprint positions in order of observation time. (NUM_FOOTPRINTS_AMSU_BB) |
| WarmPRTA11 | 5 | Number of PRTs measuring AMSU-A1-1 warm target (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15) |
| WarmPRTA12 | 5 | Number of PRTs measuring AMSU-A1-2 warm target (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8) |

| | | |
|---|---|---|
| WarmPRTA2 | 7 | Number of PRTs measuring AMSU-A2 warm target (AMSU-A2 is AMSU-A channels 1 & 2) |

## Geolocation Fields

These fields appear for every footprint (GeoTrack * GeoXTrack times) and correspond to footprint center coordinates and "shutter" time.

| Name | Explanation |
|---|---|
| Latitude | Footprint boresight geodetic Latitude in degrees North (-90.0 ... 90.0) |
| Longitude | Footprint boresight geodetic Longitude in degrees East (-180.0 ... 180.0) |
| Time | Footprint "shutter" TAI Time: floating-point elapsed seconds since Jan 1, 1993 |

## Attributes

These fields appear only once per granule and use the HDF-EOS "Attribute" interface.

| Name | Type | Explanation |
|---|---|---|
| processing_level | string of 8-bit characters | Zero-terminated character string denoting processing level ("level1B") |
| instrument | string of 8-bit characters | Zero-terminated character string denoting instrument ("AMSU-A") |
| DayNightFlag | string of 8-bit characters | Zero-terminated character string set to "Night" when the subsatellite points at the beginning and end of a granule are both experiencing night according to the "civil twilight" standard (center of refracted sun is below the horizon). It is set to "Day" when both are experiencing day, and "Both" when one is experiencing day and the other night. "NA" is used when a determination cannot be made. |
| AutomaticQAFlag | string of 8-bit characters | Zero-terminated character string denoting granule data quality: (Always "Passed", "Failed", or "Suspect") |
| NumTotalData | 32-bit integer | Total number of expected channels * scene FOVs |
| NumProcessData | 32-bit integer | Number of channels * scene FOVs which are present and can be processed routinely (state = 0) |
| NumSpecialData | 32-bit integer | Number of channels * scene FOVs which are present and can be processed only as a special test (state = 1) |
| NumBadData | 32-bit integer | Number of channels * scene FOVs which are present but cannot be processed (state = 2) |
| NumMissingData | 32-bit integer | Number of expected channels * scene FOVs which are not present (state = 3) |
| NumLandSurface | 32-bit integer | Number of scene footprints for which the surface is more than 90% land |
| NumOceanSurface | 32-bit integer | Number of scene footprints for which the surface is less than 10% land |
| node_type | string of 8-bit characters | Zero-terminated character string denoting whether granule is ascending, descending, or pole-crossing: ("Ascending" and "Descending" for entirely ascending or entirely descending granules, or "NorthPole" or "SouthPole" for pole-crossing granules. "NA" when determination cannot be made.) |
| start_year | 32-bit integer | Year in which granule started, UTC (e.g. 1999) |
| start_month | 32-bit integer | Month in which granule started, UTC (1 ... 12) |
| start_day | 32-bit integer | Day of month in which granule started, UTC (1 ... 31) |
| start_hour | 32-bit integer | Hour of day in which granule started, UTC (0 ... 23) |
| start_minute | 32-bit integer | Minute of hour in which granule started, UTC (0 ... 59) |
| start_sec | 32-bit floating-point | Second of minute in which granule started, UTC (0.0 ... 59.0) |
| start_orbit | 32-bit integer | Orbit number of mission in which granule started |
| end_orbit | 32-bit integer | Orbit number of mission in which granule ended |
| orbit_path | 32-bit integer | Orbit path of start orbit (1 ... 233 as defined by EOS project) |
| start_orbit_row | 32-bit integer | Orbit row at start of granule (1 ... 248 as defined by EOS project) |
| end_orbit_row | 32-bit integer | Orbit row at end of granule (1 ... 248 as defined by EOS project) |
| granule_number | 32-bit integer | Number of granule within day (1 ... 240) |
| num_scansets | 32-bit integer | Number of scansets in granule (1 ... 45) |

| | | |
|---|---|---|
| num_scanlines | 32-bit integer | Number of scanlines in granule (1 * num_scansets) |
| start_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees North (-90.0 ... 90.0) |
| start_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees East (-180.0 ... 180.0) |
| start_Time | 64-bit floating-point | TAI Time at start of granule (floating-point elapsed seconds since start of 1993) |
| end_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees North (-90.0 ... 90.0) |
| end_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees East (-180.0 ... 180.0) |
| end_Time | 64-bit floating-point | TAI Time at end of granule (floating-point elapsed seconds since start of 1993) |
| eq_x_longitude | 32-bit floating-point | Longitude of spacecraft at southward equator crossing nearest granule start in degrees East (-180.0 ... 180.0) |
| eq_x_tai | 64-bit floating-point | Time of eq_x_longitude in TAI units (floating-point elapsed seconds since start of 1993) |
| orbitgeoqa | 32-bit unsigned integer | See Appendix D |
| num_satgeoqa | 16-bit integer | Number of scans with problems in satgeoqa |
| num_glintgeoqa | 16-bit integer | Number of scans with problems in glintgeoqa |
| num_moongeoqa | 16-bit integer | Number of scans with problems in moongeoqa |
| num_ftptgeoqa | 16-bit integer | Number of footprints with problems in ftptgeoqa |
| num_zengeoqa | 16-bit integer | Number of footprints with problems in zengeoqa |
| num_demgeoqa | 16-bit integer | Number of footprints with problems in demgeoqa |
| num_fpe | 16-bit integer | Number of floating point errors |
| LonGranuleCen | 16-bit integer | Geodetic Longitude of the center of the granule in degrees East (-180 ... 180) |
| LatGranuleCen | 16-bit integer | Geodetic Latitude of the center of the granule in degrees North (-90 ... 90) |
| LocTimeGranuleCen | 16-bit integer | Local solar time at the center of the granule in minutes past midnight (0 ... 1439) |
| num_scanlines_not_norm_mode_a1 | 32-bit integer | Number of scanlines not in Process state (AMSU-A1) (AMSU-A1 is AMSU-A channels 3-15) |
| num_scanlines_not_norm_mode_a2 | 32-bit integer | Number of scanlines not in Process state (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2) |
| num_missing_scanlines_a1 | 32-bit integer | Number of scanlines with state = missing (AMSU-A1) (AMSU-A1 is AMSU-A channels 3-15) |
| num_missing_scanlines_a2 | 32-bit integer | Number of scanlines with state = missing (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2) |
| num_data_gaps_a1 | 32-bit integer | Number of blocks of scanlines where State is not Process (AMSU-A1) (AMSU-A1 is AMSU-A channels 3-15) |
| num_data_gaps_a2 | 32-bit integer | Number of blocks of scanlines where State is not Process (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2) |
| num_instr_mode_changes_a1 | 32-bit integer | Number of operational instrument mode changes (AMSU-A1) (AMSU-A1 is AMSU-A channels 3-15) |
| num_instr_mode_changes_a2 | 32-bit integer | Number of operational instrument mode changes (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2) |
| num_scanlines_rec_cal_prob_a11 | 32-bit integer | Number of scanlines with non-zero qa_receiver (AMSU-A1-1) (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15) |
| num_scanlines_rec_cal_prob_a12 | 32-bit integer | Number of scanlines with non-zero qa_receiver (AMSU-A1-2) (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8) |
| num_scanlines_rec_cal_prob_a2 | 32-bit integer | Number of scanlines with non-zero qa_receiver (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2) |
| num_scanlines_sig_coast_xing | 32-bit integer | Number of scanlines with qa_scanline coast crossing bit set |
| num_scanlines_sig_sun_glint | 32-bit integer | Number of scanlines with qa_scanline sun glint bit set |
| MoonInViewMWCount | 32-bit integer | Number of scanlines in granule with the moon in the AMSU-A1 space view |

| | | |
|---|---|---|
| | | plus number of scanlines in granule with the moon in the AMSU-A2 space view (0-90) |
| QA_bb_PRT_a11 | Limited Engineering Struct (see below) | Blackbody PRT temperature summary QA (AMSU-A1-1) (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15) (C) |
| QA_bb_PRT_a12 | Limited Engineering Struct (see below) | Blackbody PRT temperature summary QA (AMSU-A1-2) (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8) (C) |
| QA_bb_PRT_a2 | Limited Engineering Struct (see below) | Blackbody PRT temperature summary QA (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2) (C) |
| QA_rec_PRT_a11 | Limited Engineering Struct (see below) | Receiver PRT temperature summary QA (AMSU-A1-1) (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15) (C) |
| QA_rec_PRT_a12 | Limited Engineering Struct (see below) | Receiver PRT temperature summary QA (AMSU-A1-2) (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8) (C) |
| QA_rec_PRT_a2 | Limited Engineering Struct (see below) | Receiver PRT temperature summary QA (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2) (C) |
| granules_present | string of 8-bit characters | Zero-terminated character string denoting which adjacent granules were available for smoothing ("All" for both previous & next, "Prev" for previous but not next, "Next" for next but not previous, "None" for neither previous nor next) |

## Per-Granule Data Fields

These fields appear only once per granule and use the HDF-EOS "Field" interface.

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| center_freq | 32-bit floating-point | Channel (= 15) | Channel Center frequency (GHz) |
| IF_offset_1 | 32-bit floating-point | Channel (= 15) | Offset of first intermediate frequency stage (MHz) (zero for no mixing) |
| IF_offset_2 | 32-bit floating-point | Channel (= 15) | Offset of second intermediate frequency stage (MHz) (zero for no second mixing) |
| bandwidth | 32-bit floating-point | Channel (= 15) | bandwidth of sum of 1, 2, or 4 channels (MHz) |
| num_calibrated_scanlines | 32-bit integer | Channel (= 15) | Number of scanlines that had calibration coefs applied |
| num_scanlines_ch_cal_problems | 32-bit integer | Channel (= 15) | Number of scanlines with non-zero qa_channel |
| bb_signals | Unlimited Engineering Struct (see below) | BBXTrack (= 2) * Channel (= 15) | Statistics on blackbody calibration signals (data numbers with offset subtracted) |
| space_signals | Unlimited Engineering Struct (see below) | SpaceXTrack (= 2) * Channel (= 15) | Statistics on spaceview calibration signals (data numbers with offset subtracted) |
| gain_stats | Unlimited Engineering Struct (see below) | Channel (= 15) | Statistics on gains (count/K) |
| NeDT | 32-bit floating-point | Channel (= 15) | Instrument noise level estimated from warm count scatter (K) |
| QA_unfiltered_scene_count | Unlimited Engineering Struct (see below) | GeoXTrack (= 30) * Channel (= 15) | Per footprint position raw scene count summary QA |
| QA_unfiltered_BB_count | Unlimited Engineering Struct (see below) | BBXTrack (= 2) * Channel (= 15) | Per BB footprint position raw warm count summary QA (unfiltered) |
| QA_unfiltered_space_count | Unlimited Engineering Struct (see below) | SpaceXTrack (= 2) * Channel (= 15) | Per space footprint position raw cold count summary QA (unfiltered) |
| QA_cal_coef_a0 | Unlimited Engineering Struct (see below) | Channel (= 15) | Calibration coefficient a0 summary QA (K) |

| | | | |
|---|---|---|---|
| QA_cal_coef_a1 | Unlimited Engineering Struct (see below) | Channel (= 15) | Calibration coefficient a1 summary QA (K/count) |
| QA_cal_coef_a2 | Unlimited Engineering Struct (see below) | Channel (= 15) | Calibration coefficient a2 summary QA (K/count**2) |
| QA_bb_raw_noise_counts | Unlimited Engineering Struct (see below) | Channel (= 15) | Summary QA on differences between warm cal counts, DT=ABS(T1-T2)/SQRT(2) |
| QA_sv_raw_noise_counts | Unlimited Engineering Struct (see below) | Channel (= 15) | Summary QA on differences between cold cal counts, DT=ABS(T1-T2)/SQRT(2) |

## Along-Track Data Fields

These fields appear once per scanline (GeoTrack times).

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| satheight | 32-bit floating-point | None | Satellite altitude at nadirTAI in km above reference ellipsoid (e.g. 725.2) |
| satroll | 32-bit floating-point | None | Satellite attitude roll angle at nadirTAI (-180.0 ... 180.0 angle about the +x (roll) ORB axis, +x axis is positively oriented in the direction of orbital flight completing an orthogonal triad with y and z.) |
| satpitch | 32-bit floating-point | None | Satellite attitude pitch angle at nadirTAI (-180.0 ... 180.0 angle about +y (pitch) ORB axis. +y axis is oriented normal to the orbit plane with the positive sense opposite to that of the orbit's angular momentum vector H.) |
| satyaw | 32-bit floating-point | None | Satellite attitude yaw angle at nadirTAI (-180.0 ... 180.0 angle about +z (yaw) axis. +z axis is positively oriented Earthward parallel to the satellite radius vector R from the spacecraft center of mass to the center of the Earth.) |
| satgeoqa | 32-bit unsigned integer | None | See Appendix D |
| glintgeoqa | 16-bit unsigned integer | None | See Appendix D |
| moongeoqa | 16-bit unsigned integer | None | See Appendix D |
| nadirTAI | 64-bit floating-point | None | TAI time at which instrument is nominally looking directly down. (between footprints 15 & 16 for AMSU or between footprints 45 & 46 for AIRS/Vis & HSB) (floating-point elapsed seconds since start of 1993) |
| sat_lat | 64-bit floating-point | None | Satellite geodetic latitude in degrees North (-90.0 ... 90.0) |
| sat_lon | 64-bit floating-point | None | Satellite geodetic longitude in degrees East (-180.0 ... 180.0) |
| scan_node_type | 8-bit integer | None | 'A' for ascending, 'D' for descending, 'E' when an error is encountered in trying to determine a value. |
| glintlat | 32-bit floating-point | None | Solar glint geodetic latitude in degrees North at nadirTAI (-90.0 ... 90.0) |
| glintlon | 32-bit floating-point | None | Solar glint geodetic longitude in degrees East at nadirTAI (-180.0 ... 180.0) |
| state1 | 32-bit integer | None | Data state for AMSU-A1: 0:Process, 1:Special, 2:Erroneous, 3:Missing |
| state2 | 32-bit integer | None | Data state for AMSU-A2: 0:Process, 1:Special, 2:Erroneous, 3:Missing (AMSU-A2 is AMSU-A channels 1 and 2) |
| cal_coef_a0 | 32-bit floating-point | Channel (= 15) | Calibration coefficients to convert raw counts to antenna temperature (K) |
| cal_coef_a0_err | 32-bit floating- | Channel (= 15) | Error estimate for cal_coef_a0 (K) |

| | | | |
|---|---|---|---|
| | point | | |
| cal_coef_a1 | 32-bit floating-point | Channel (= 15) | Calibration coefficients to convert raw counts to antenna temperature (K/count) |
| cal_coef_a1_err | 32-bit floating-point | Channel (= 15) | Error estimate for cal_coef_a1 (K/count) |
| cal_coef_a2 | 32-bit floating-point | Channel (= 15) | Calibration coefficients to convert raw counts to antenna temperature (K/count**2) |
| cal_coef_a2_err | 32-bit floating-point | Channel (= 15) | Error estimate for cal_coef_a2 (K/count**2) |
| a1_ColdCalPstion | 8-bit integer | None | AMSU-A1 Cold Calibration Position 1-4 (Binary 0-3) |
| a2_ColdCalPstion | 8-bit integer | None | AMSU-A2 Cold Calibration Position 1-4 (Binary 0-3) (AMSU-A2 is AMSU-A channels 1 and 2) |
| a1_PLO_Redundncy | 8-bit integer | None | AMSU-A1 PLO Redundancy, 1: default (PLO 2);<br>0: redundant (PLO 1) |
| a11_mux_temp_used | 8-bit integer | None | AMSU-A1-1 MUX Temperature use flag. (1: used MUX temperature for AMSU-A1 receiver temperature;<br>0: used RF shelf temperature) (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15) |
| a11_receiver_temp | 32-bit floating-point | None | AMSU-A1-1 receiver temperature used in calibration (MUX temperature or RF shelf temperature as specified by a11_mux_temp_used) (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15) (C) |
| a11_target_temp | 32-bit floating-point | None | AMSU-A1-1 target temperature used in calibration (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15) (C) |
| a12_mux_temp_used | 8-bit integer | None | AMSU-A1-2 MUX Temperature use flag. (1: used MUX temperature for AMSU-A1 receiver temperature;<br>0: used RF shelf temperature) (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8) |
| a12_receiver_temp | 32-bit floating-point | None | AMSU-A1-2 receiver temperature used in calibration (MUX temperature or RF shelf temperature as specified by a12_mux_temp_used) (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8) (C) |
| a12_target_temp | 32-bit floating-point | None | AMSU-A1-2 target temperature used in calibration (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8) (C) |
| a2_diplexer_temp_used | 8-bit integer | None | AMSU-A2 diplexer Temperature use flag. (1: used diplexer temperature for AMSU-A2 receiver temperature;<br>0: used RF shelf temperature) (AMSU-A2 is AMSU-A channels 1 and 2) |
| a2_receiver_temp | 32-bit floating-point | None | AMSU-A2 receiver temperature used in calibration (diplexer temperature or RF shelf temperature as specified by a2_diplexer_temp_used) (AMSU-A2 is AMSU-A channels 1 and 2) (C) |
| a2_target_temp | 32-bit floating-point | None | AMSU-A2 target temperature used in calibration (AMSU-A2 is AMSU-A channels 1 and 2) (C) |
| qa_scanline | 8-bit unsigned integer | None | Scanline bitmap for AMSU-A: Bit 0: (LSB, value 1) Sun glint in this scanline;<br>Bit 1: (value 2) Coastal crossing in this scanline;<br>Bit 2: (value 4) Some channels had excessive NeDT estimate;<br>Bit 3: (value 8) Near sidelobe correction applied |
| qa_receiver_a11 | 8-bit unsigned integer | None | Receiver bitmap for AMSU-A1-1 (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15): Bit 0: (LSB, value 1) Calibration was not derived, due to the instrument mode;<br>Bit 1: (value 2) Calibration was not derived, due to bad or missing PRT values;<br>Bit 2: (value 4) This scanline was calibrated, but the moon was in the space view;<br>Bit 3: (value 8) This scanline was calibrated, but there was a space view scan position err;<br>Bit 4: (value 16) This scanline was calibrated, but there was a blackbody scan position error;<br>Bit 5: (value 32) This scanline was calibrated, but some PRT values were bad or marginal;<br>Bit 6: (value 64) This scanline was calibrated, but there was a data gap;<br>Bit 7: (value 128) Some channels were not calibrated |

| | | | |
|---|---|---|---|
| qa_receiver_a12 | 8-bit unsigned integer | None | Receiver bitmap for AMSU-A1-2:Same fields as defined for qa_receiver_a11 |
| qa_receiver_a2 | 8-bit unsigned integer | None | Receiver bitmap for AMSU-A2:Same fields as defined for qa_receiver_a11 |
| qa_channel | 8-bit unsigned integer | Channel (= 15) | Channel bitmap for AMSU-A: Bit 0: (LSB, value 1) All space view counts were bad for this channel and scanline;<br>Bit 1: (value 2) Space view counts were marginal for this channel and scanline;<br>Bit 2: (value 4) Space view counts could not be smoothed;<br>Bit 3: (value 8) All blackbody counts were bad for this channel and scanline;<br>Bit 4: (value 16) Blackbody counts were marginal for this channel and scanline;<br>Bit 5: (value 32) Blackbody counts could not be smoothed;<br>Bit 6: (value 64) Unable to calculate calibration coefficients for this scanline, most recent valid coefficients used instead;<br>Bit 7: (value 128) Excessive NeDT estimated |

## Full Swath Data Fields

These fields appear for every footprint of every scanline in the granule (GeoTrack * GeoXTrack times).

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| scanang | 32-bit floating-point | None | Scanning angle of AMSU-A instrument with respect to the AMSU-A Instrument for this footprint (-180.0 ... 180.0, negative at start of scan, 0 at nadir) |
| ftptgeoqa | 32-bit unsigned integer | None | See Appendix D |
| zengeoqa | 16-bit unsigned integer | None | See Appendix D |
| demgeoqa | 16-bit unsigned integer | None | See Appendix D |
| satzen | 32-bit floating-point | None | Spacecraft zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| satazi | 32-bit floating-point | None | Spacecraft azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| solzen | 32-bit floating-point | None | Solar zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| solazi | 32-bit floating-point | None | Solar azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| sun_glint_distance | 16-bit integer | None | Distance (km) from footprint center to location of the sun glint (-9999 for unknown, 30000 for no glint visible because spacecraft is in Earth's shadow) |
| topog | 32-bit floating-point | None | Mean topography in meters above reference ellipsoid |
| topog_err | 32-bit floating-point | None | Error estimate for topog |
| landFrac | 32-bit floating-point | None | Fraction of spot that is land (0.0 ... 1.0) |
| landFrac_err | 32-bit floating-point | None | Error estimate for landFrac |
| antenna_temp | 32-bit floating-point | Channel (= 15) | Raw antenna temperature in Kelvins |
| brightness_temp | 32-bit floating-point | Channel (= 15) | Antenna temperatures, with an empirically derived correction applied to compensate for scan-position dependent bias. This correction is derived from AIRS retrievals. (K) |
| brightness_temp_err | 32-bit floating-point | Channel (= 15) | Uncertainty in empirically derived brightness_temp bias correction, excluding radiometer noise. (K) |

## Special AIRS Types

AIRS works around the lack of support for records in HDF-EOS Swath by grouping related fields into pseudo-records. HDF-EOS fieldnames are generated by concatenating the pseudo-record name with the subfield name, putting a "." character in between. Since these record types do not exist at the HDF-EOS swath level, reading subfield "min" of AIRS field "QA_bb_PRT_a11" involves reading HDF-EOS Swath field "QA_bb_PRT_a11.min".

Limited Engineering Struct: This type is used for engineering data fields for which there are known "yellow" limits.

| Field Name | Type | Explanation |
|---|---|---|
| min | 32-bit floating-point | Minimum value field takes on in granule (not valid when num_in = 0) |
| max | 32-bit floating-point | Maximum value field takes on in granule (not valid when num_in = 0) |
| mean | 32-bit floating-point | Mean of values field takes on in granule (not valid when num_in = 0) |
| dev | 32-bit floating-point | Standard Deviation of values field takes on in granule (not valid when num_in < 2) |
| num_in | 32-bit integer | Count of in-range values field takes on in granule |
| num_lo | 32-bit integer | Count of out-of-range low values field takes on in granule |
| num_hi | 32-bit integer | Count of out-of-range high values field takes on in granule |
| num_bad | 32-bit integer | Count of occassions on which field takes on invalid flag value (-9999) in granule |
| range_min | 32-bit floating-point | Minimum in-range value. |
| range_max | 32-bit floating-point | Maximum in-range value. |
| missing | 8-bit integer | Missing limits flags. Bit 0 (LSB) is 1 when yellow low (range_min) limit is missing;<br>Bit 1 is high when yellow high (range_max) limit is missing;<br>other bits unused, set to 0. |
| max_track | 32-bit integer | GeoTrack index (counting from 1) where max was found |
| max_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where max was found |
| min_track | 32-bit integer | GeoTrack index (counting from 1) where min was found |
| min_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where min was found |

Unlimited Engineering Struct: This type is used for engineering data fields for which there are NOT known "yellow" limits.

| Field Name | Type | Explanation |
|---|---|---|
| min | 32-bit floating-point | Minimum value field takes on in granule (not valid when num_in = 0) |
| max | 32-bit floating-point | Maximum value field takes on in granule (not valid when num_in = 0) |
| mean | 32-bit floating-point | Mean of values field takes on in granule (not valid when num_in = 0) |
| dev | 32-bit floating-point | Standard Deviation of values field takes on in granule (not valid when num_in < 2) |
| num | 32-bit integer | Count of occurrences of field in granule (not including those counted in num_bad) |
| num_bad | 32-bit integer | Count of occassions on which field takes on invalid flag value (-9999) in granule |
| max_track | 32-bit integer | GeoTrack index (counting from 1) where max was found |
| max_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where max was found |
| min_track | 32-bit integer | GeoTrack index (counting from 1) where min was found |
| min_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where min was found |

# A1-6. L1B AMSU QA Interface Specification

Interface Specification Version 5.0.14.0
2007-04-11

ESDT ShortName = "AIRABQAP"

Swath Name = "L1B_AMSU_QASup"

Level = "level1B"

# Footprints = 30

# scanlines per scanset = 1

## Dimensions

These fields define all dimensions that can be used for HDF-EOS swath fields.

The names "GeoTrack" and "GeoXTrack" have a special meaning for this document: "Cross-Track" data fields have a hidden dimension of "GeoXTrack"; "Along-Track" data fields have a hidden dimension of "GeoTrack"; "Full Swath" data fields have hidden dimensions of both "GeoTrack" and "GeoXTrack".

| Name | Value | Explanation |
|---|---|---|
| GeoXTrack | 30 | Dimension across track for footprint positions. Same as number of footprints per scanline. -- starting at the left and increasing towards the right as you look along the satellite's path |
| GeoTrack | # of scan lines in swath | Dimension along track for footprint positions. Same as number of scanlines in granule. Parallel to the satellite's path, increasing with time. (Nominally 45 for Level-2, AMSU-A, and AIRS/Vis low-rate engineering;<br>135 for AIRS/Vis and HSB high-rate quantities) |
| Channel | 15 | Dimension of channel array (Channel 1: 23.8 GHz;<br>Ch 2: 31.4 GHz;<br>Ch 3: 50.3 GHz;<br>Ch 4: 52.8 GHz;<br>Ch 5: 53.596 +/- 0.115 GHz;<br>Ch 6: 54.4 GHz;<br>Ch 7: 54.94 GHz;<br>Ch 8: 55.5 GHz;<br>Ch 9: f0;<br>Ch 10: f0 +/- 0.217 GHz Ch 11: f0 +/- df +/- 48 MHz;<br>Ch 12: f0 +/- df +/- 22 MHz;<br>Ch 13: f0 +/- df +/- 10 MHz;<br>Ch 14: f0 +/- df +/- 4.5 MHz;<br>Ch 15: 89 GHz (f0 = 57290.344 MHz;<br>df = 322.4 MHz)) |
| CalXTrack | 4 | Dimension "across" track for calibration footprint positions. Same as number of calibration footprints per scanline. (NUM_FOOTPRINTS_AMSU_CALIB) (Footprints are ordered: 1-2: spaceviews;<br>3-4: blackbody radiometric calibration source) |
| SpaceXTrack | 2 | Dimension "across" track for spaceview calibration footprint positions in order of observation time. (NUM_FOOTPRINTS_AMSU_SPACE) |
| BBXTrack | 2 | Dimension "across" track for blackbody calibration footprint positions in order of observation time. (NUM_FOOTPRINTS_AMSU_BB) |
| WarmPRTA11 | 5 | Number of PRTs measuring AMSU-A1-1 warm target (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15) |
| WarmPRTA12 | 5 | Number of PRTs measuring AMSU-A1-2 warm target (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8) |

| | | |
|---|---|---|
| WarmPRTA2 | 7 | Number of PRTs measuring AMSU-A2 warm target (AMSU-A2 is AMSU-A channels 1 & 2) |

## Geolocation Fields

These fields appear for every footprint (GeoTrack * GeoXTrack times) and correspond to footprint center coordinates and "shutter" time.

| Name | Explanation |
|---|---|
| Latitude | Footprint boresight geodetic Latitude in degrees North (-90.0 ... 90.0) |
| Longitude | Footprint boresight geodetic Longitude in degrees East (-180.0 ... 180.0) |
| Time | Footprint "shutter" TAI Time: floating-point elapsed seconds since Jan 1, 1993 |

## Attributes

These fields appear only once per granule and use the HDF-EOS "Attribute" interface.

| Name | Type | Explanation |
|---|---|---|
| processing_level | string of 8-bit characters | Zero-terminated character string denoting processing level ("level1B") |
| instrument | string of 8-bit characters | Zero-terminated character string denoting instrument ("AMSU-A") |
| DayNightFlag | string of 8-bit characters | Zero-terminated character string set to "Night" when the subsatellite points at the beginning and end of a granule are both experiencing night according to the "civil twilight" standard (center of refracted sun is below the horizon). It is set to "Day" when both are experiencing day, and "Both" when one is experiencing day and the other night. "NA" is used when a determination cannot be made. |
| AutomaticQAFlag | string of 8-bit characters | Zero-terminated character string denoting granule data quality: (Always "Passed", "Failed", or "Suspect") |
| NumTotalData | 32-bit integer | Total number of expected channels * scene FOVs |
| NumProcessData | 32-bit integer | Number of channels * scene FOVs which are present and can be processed routinely (state = 0) |
| NumSpecialData | 32-bit integer | Number of channels * scene FOVs which are present and can be processed only as a special test (state = 1) |
| NumBadData | 32-bit integer | Number of channels * scene FOVs which are present but cannot be processed (state = 2) |
| NumMissingData | 32-bit integer | Number of expected channels * scene FOVs which are not present (state = 3) |
| NumLandSurface | 32-bit integer | Number of scene footprints for which the surface is more than 90% land |
| NumOceanSurface | 32-bit integer | Number of scene footprints for which the surface is less than 10% land |
| node_type | string of 8-bit characters | Zero-terminated character string denoting whether granule is ascending, descending, or pole-crossing: ("Ascending" and "Descending" for entirely ascending or entirely descending granules, or "NorthPole" or "SouthPole" for pole-crossing granules. "NA" when determination cannot be made.) |
| start_year | 32-bit integer | Year in which granule started, UTC (e.g. 1999) |
| start_month | 32-bit integer | Month in which granule started, UTC (1 ... 12) |
| start_day | 32-bit integer | Day of month in which granule started, UTC (1 ... 31) |
| start_hour | 32-bit integer | Hour of day in which granule started, UTC (0 ... 23) |
| start_minute | 32-bit integer | Minute of hour in which granule started, UTC (0 ... 59) |
| start_sec | 32-bit floating-point | Second of minute in which granule started, UTC (0.0 ... 59.0) |
| start_orbit | 32-bit integer | Orbit number of mission in which granule started |
| end_orbit | 32-bit integer | Orbit number of mission in which granule ended |
| orbit_path | 32-bit integer | Orbit path of start orbit (1 ... 233 as defined by EOS project) |
| start_orbit_row | 32-bit integer | Orbit row at start of granule (1 ... 248 as defined by EOS project) |
| end_orbit_row | 32-bit integer | Orbit row at end of granule (1 ... 248 as defined by EOS project) |
| granule_number | 32-bit integer | Number of granule within day (1 ... 240) |
| num_scansets | 32-bit integer | Number of scansets in granule (1 ... 45) |

| | | |
|---|---|---|
| num_scanlines | 32-bit integer | Number of scanlines in granule (1 * num_scansets) |
| start_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees North (-90.0 ... 90.0) |
| start_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees East (-180.0 ... 180.0) |
| start_Time | 64-bit floating-point | TAI Time at start of granule (floating-point elapsed seconds since start of 1993) |
| end_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees North (-90.0 ... 90.0) |
| end_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees East (-180.0 ... 180.0) |
| end_Time | 64-bit floating-point | TAI Time at end of granule (floating-point elapsed seconds since start of 1993) |
| eq_x_longitude | 32-bit floating-point | Longitude of spacecraft at southward equator crossing nearest granule start in degrees East (-180.0 ... 180.0) |
| eq_x_tai | 64-bit floating-point | Time of eq_x_longitude in TAI units (floating-point elapsed seconds since start of 1993) |
| orbitgeoqa | 32-bit unsigned integer | See Appendix D |
| num_satgeoqa | 16-bit integer | Number of scans with problems in satgeoqa |
| num_glintgeoqa | 16-bit integer | Number of scans with problems in glintgeoqa |
| num_moongeoqa | 16-bit integer | Number of scans with problems in moongeoqa |
| num_ftptgeoqa | 16-bit integer | Number of footprints with problems in ftptgeoqa |
| num_zengeoqa | 16-bit integer | Number of footprints with problems in zengeoqa |
| num_demgeoqa | 16-bit integer | Number of footprints with problems in demgeoqa |
| num_fpe | 16-bit integer | Number of floating point errors |
| LonGranuleCen | 16-bit integer | Geodetic Longitude of the center of the granule in degrees East (-180 ... 180) |
| LatGranuleCen | 16-bit integer | Geodetic Latitude of the center of the granule in degrees North (-90 ... 90) |
| LocTimeGranuleCen | 16-bit integer | Local solar time at the center of the granule in minutes past midnight (0 ... 1439) |
| num_scanlines_not_norm_mode_a1 | 32-bit integer | Number of scanlines not in Process state (AMSU-A1) (AMSU-A1 is AMSU-A channels 3-15) |
| num_scanlines_not_norm_mode_a2 | 32-bit integer | Number of scanlines not in Process state (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2) |
| num_missing_scanlines_a1 | 32-bit integer | Number of scanlines with state = missing (AMSU-A1) (AMSU-A1 is AMSU-A channels 3-15) |
| num_missing_scanlines_a2 | 32-bit integer | Number of scanlines with state = missing (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2) |
| num_data_gaps_a1 | 32-bit integer | Number of blocks of scanlines where State is not Process (AMSU-A1) (AMSU-A1 is AMSU-A channels 3-15) |
| num_data_gaps_a2 | 32-bit integer | Number of blocks of scanlines where State is not Process (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2) |
| num_instr_mode_changes_a1 | 32-bit integer | Number of operational instrument mode changes (AMSU-A1) (AMSU-A1 is AMSU-A channels 3-15) |
| num_instr_mode_changes_a2 | 32-bit integer | Number of operational instrument mode changes (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2) |
| num_scanlines_rec_cal_prob_a11 | 32-bit integer | Number of scanlines with non-zero qa_receiver (AMSU-A1-1) (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15) |
| num_scanlines_rec_cal_prob_a12 | 32-bit integer | Number of scanlines with non-zero qa_receiver (AMSU-A1-2) (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8) |
| num_scanlines_rec_cal_prob_a2 | 32-bit integer | Number of scanlines with non-zero qa_receiver (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2) |
| num_scanlines_sig_coast_xing | 32-bit integer | Number of scanlines with qa_scanline coast crossing bit set |
| num_scanlines_sig_sun_glint | 32-bit integer | Number of scanlines with qa_scanline sun glint bit set |
| MoonInViewMWCount | 32-bit integer | Number of scanlines in granule with the moon in the AMSU-A1 space view |

| | | |
|---|---|---|
| | | plus number of scanlines in granule with the moon in the AMSU-A2 space view (0-90) |
| QA_bb_PRT_a11 | Limited Engineering Struct (see below) | Blackbody PRT temperature summary QA (AMSU-A1-1) (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15) (C) |
| QA_bb_PRT_a12 | Limited Engineering Struct (see below) | Blackbody PRT temperature summary QA (AMSU-A1-2) (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8) (C) |
| QA_bb_PRT_a2 | Limited Engineering Struct (see below) | Blackbody PRT temperature summary QA (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2) (C) |
| QA_rec_PRT_a11 | Limited Engineering Struct (see below) | Receiver PRT temperature summary QA (AMSU-A1-1) (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15) (C) |
| QA_rec_PRT_a12 | Limited Engineering Struct (see below) | Receiver PRT temperature summary QA (AMSU-A1-2) (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8) (C) |
| QA_rec_PRT_a2 | Limited Engineering Struct (see below) | Receiver PRT temperature summary QA (AMSU-A2) (AMSU-A2 is AMSU-A channels 1 and 2) (C) |
| granules_present | string of 8-bit characters | Zero-terminated character string denoting which adjacent granules were available for smoothing ("All" for both previous & next, "Prev" for previous but not next, "Next" for next but not previous, "None" for neither previous nor next) |
| QA_a11_warm_load_1_temp | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_a11_warm_load_2_temp | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_a11_warm_load_3_temp | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_a11_warm_load_4_temp | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_a11_warm_load_c_temp | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_a11_rf_shelf_temp | Limited Engineering Struct (see below) | Receiver temperature QA (C) |
| QA_a11_rf_mux_temp | Limited Engineering Struct (see below) | Backup receiver temperature QA (C) |
| QA_a11_ref_PRT_select | 32-bit unsigned integer | Number of times backup reference PRT selected |
| QA_a12_warm_load_1_temp | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_a12_warm_load_2_temp | Limited | Warm target temperature QA (C) |

| | | |
|---|---|---|
| | Engineering Struct (see below) | |
| QA_a12_warm_load_3_temp | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_a12_warm_load_4_temp | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_a12_warm_load_c_temp | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_a12_rf_shelf_temp | Limited Engineering Struct (see below) | Receiver temperature QA (C) |
| QA_a12_rf_mux_temp | Limited Engineering Struct (see below) | Backup receiver temperature QA (C) |
| QA_a12_ref_PRT_select | 32-bit unsigned integer | Number of times backup reference PRT selected |
| QA_a2_warm_load_1_temp | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_a2_warm_load_2_temp | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_a2_warm_load_3_temp | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_a2_warm_load_4_temp | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_a2_warm_load_5_temp | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_a2_warm_load_6_temp | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_a2_warm_load_c_temp | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_a2_rf_shelf_temp | Limited Engineering Struct (see below) | Receiver temperature QA (C) |
| QA_a2_rf_diplexer_temp | Limited Engineering Struct (see below) | Backup receiver temperature QA (C) |
| QA_a2_ref_PRT_select | 32-bit unsigned integer | Number of times backup reference PRT selected |
| QA_a11_NFAIL_primPRT | Reference PRT counts (see | Failure counts for AMSU-A1-1 primary reference PRT |

| | | |
|---|---|---|
| | below) | |
| QA_a11_NFAIL_secPRT | Reference PRT counts (see below) | Failure counts for AMSU-A1-1 secondary reference PRT |
| QA_a12_NFAIL_primPRT | Reference PRT counts (see below) | Failure counts for AMSU-A1-2 primary reference PRT |
| QA_a12_NFAIL_secPRT | Reference PRT counts (see below) | Failure counts for AMSU-A1-2 secondary reference PRT |
| QA_a2_NFAIL_primPRT | Reference PRT counts (see below) | Failure counts for AMSU-A2 primary reference PRT |
| QA_a2_NFAIL_secPRT | Reference PRT counts (see below) | Failure counts for AMSU-A2 secondary reference PRT |

## Per-Granule Data Fields

These fields appear only once per granule and use the HDF-EOS "Field" interface.

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| center_freq | 32-bit floating-point | Channel (= 15) | Channel Center frequency (GHz) |
| IF_offset_1 | 32-bit floating-point | Channel (= 15) | Offset of first intermediate frequency stage (MHz) (zero for no mixing) |
| IF_offset_2 | 32-bit floating-point | Channel (= 15) | Offset of second intermediate frequency stage (MHz) (zero for no second mixing) |
| bandwidth | 32-bit floating-point | Channel (= 15) | bandwidth of sum of 1, 2, or 4 channels (MHz) |
| num_calibrated_scanlines | 32-bit integer | Channel (= 15) | Number of scanlines that had calibration coefs applied |
| num_scanlines_ch_cal_problems | 32-bit integer | Channel (= 15) | Number of scanlines with non-zero qa_channel |
| bb_signals | Unlimited Engineering Struct (see below) | BBXTrack (= 2) * Channel (= 15) | Statistics on blackbody calibration signals (data numbers with offset subtracted) |
| space_signals | Unlimited Engineering Struct (see below) | SpaceXTrack (= 2) * Channel (= 15) | Statistics on spaceview calibration signals (data numbers with offset subtracted) |
| gain_stats | Unlimited Engineering Struct (see below) | Channel (= 15) | Statistics on gains (count/K) |
| NeDT | 32-bit floating-point | Channel (= 15) | Instrument noise level estimated from warm count scatter (K) |
| QA_unfiltered_scene_count | Unlimited Engineering Struct (see below) | GeoXTrack (= 30) * Channel (= 15) | Per footprint position raw scene count summary QA |
| QA_unfiltered_BB_count | Unlimited Engineering Struct (see below) | BBXTrack (= 2) * Channel (= 15) | Per BB footprint position raw warm count summary QA (unfiltered) |
| QA_unfiltered_space_count | Unlimited Engineering Struct (see below) | SpaceXTrack (= 2) * Channel (= 15) | Per space footprint position raw cold count summary QA (unfiltered) |
| QA_cal_coef_a0 | Unlimited Engineering Struct (see below) | Channel (= 15) | Calibration coefficient a0 summary QA (K) |
| QA_cal_coef_a1 | Unlimited Engineering Struct (see below) | Channel (= 15) | Calibration coefficient a1 summary QA (K/count) |
| QA_cal_coef_a2 | Unlimited Engineering Struct (see below) | Channel (= 15) | Calibration coefficient a2 summary QA (K/count**2) |
| QA_bb_raw_noise_counts | Unlimited Engineering Struct | Channel (= 15) | Summary QA on differences between warm cal counts, DT=ABS(T1-T2)/SQRT(2) |

| | | | |
|---|---|---|---|
| | (see below) | | |
| QA_sv_raw_noise_counts | Unlimited Engineering Struct (see below) | Channel (= 15) | Summary QA on differences between cold cal counts, DT=ABS(T1-T2)/SQRT(2) |
| QA_raw_cold_count | Limited Engineering Struct (see below) | Channel (= 15) | Raw cold count summary QA |
| QA_raw_warm_count | Limited Engineering Struct (see below) | Channel (= 15) | Raw warm count summary QA |
| QA_cold_count | Unlimited Engineering Struct (see below) | Channel (= 15) | (qual and averaged) Cold count summary QA |
| QA_warm_count | Unlimited Engineering Struct (see below) | Channel (= 15) | (qual and averaged) Warm count summary QA |
| QA_smoothed_cold_count | Unlimited Engineering Struct (see below) | Channel (= 15) | Smoothed cold count summary QA |
| QA_smoothed_warm_count | Unlimited Engineering Struct (see below) | Channel (= 15) | Smoothed warm count summary QA |
| QA_raw_count | Unlimited Engineering Struct (see below) | Channel (= 15) | Science count summary QA |
| QA_a11_NFAIL_wPRT | Warm PRT counts (see below) | WarmPRTA11 (= 5) | Failure counts for AMSU-A1-1 warm target PRT |
| QA_a12_NFAIL_wPRT | Warm PRT counts (see below) | WarmPRTA12 (= 5) | Failure counts for AMSU-A1-2 warm target PRT |
| QA_a2_NFAIL_wPRT | Warm PRT counts (see below) | WarmPRTA2 (= 7) | Failure counts for AMSU-A2 warm target PRT |
| QA_NFAIL_WC_bad_val | 16-bit integer | Channel (= 15) | Number of warm target input count failures per channel for bad values |
| QA_NFAIL_WC_lo_lim | 16-bit integer | Channel (= 15) | Number of warm target input count failures per channel for Low limit violation |
| QA_NFAIL_WC_hi_lim | 16-bit integer | Channel (= 15) | Number of warm target input count failures per channel for High limit violation |
| QA_NFAIL_CC_bad_val | 16-bit integer | Channel (= 15) | Number of cold cal (space view) input count failures per channel for bad values |
| QA_NFAIL_CC_lo_lim | 16-bit integer | Channel (= 15) | Number of cold cal (space view) input count failures per channel for Low limit violation |
| QA_NFAIL_CC_hi_lim | 16-bit integer | Channel (= 15) | Number of cold cal (space view) input count failures per channel for High limit violation |
| QA_NFAIL_CC_moon_flag | 16-bit integer | Channel (= 15) | Number of cold cal (space view) input count failures per channel for moon in field-of-view |
| QA_NFAIL_CAL_not_proc_state | 16-bit integer | Channel (= 15) | Number of calibration failures per channel for data not in process state (missing or special calibration mode or bad) |
| QA_NFAIL_CAL_no_reuse_coef | 16-bit integer | Channel (= 15) | Number of calibration failures per channel for lack of reusable a0, a1, & a2 coefficients |
| QA_NFAIL_CAL_ref_PRT | 16-bit integer | Channel (= 15) | Number of calibration failures per channel for problems with the reference PRTs |
| QA_NFAIL_CAL_warm_temp | 16-bit integer | Channel (= 15) | Number of calibration failures per channel for determination of warm target temperature |
| QA_NFAIL_CAL_cold_temp | 16-bit integer | Channel (= 15) | Number of calibration failures per channel for determination of cold cal (space view) temperature |
| QA_NFAIL_CAL_wC_no_val_data | 16-bit integer | Channel (= 15) | Number of calibration failures per channel for insufficient valid warm calibration data |
| QA_NFAIL_CAL_wC_in_scan | 16-bit integer | Channel (= 15) | Number of calibration failures per channel for excessive in-scan warm count variability |
| QA_NFAIL_CAL_wC_smoothing | 16-bit integer | Channel (= 15) | Number of calibration failures per channel for |

| | | | |
|---|---|---|---|
| | | | insufficient raw warm counts for smoothing |
| QA_NFAIL_CAL_cC_no_val_data | 16-bit integer | Channel (= 15) | Number of calibration failures per channel for insufficient valid cold cal (space view) data |
| QA_NFAIL_CAL_cC_in_scan | 16-bit integer | Channel (= 15) | Number of calibration failures per channel for excessive in-scan cold cal (space view) count variability |
| QA_NFAIL_CAL_cC_smoothing | 16-bit integer | Channel (= 15) | Number of calibration failures per channel for insufficient raw cold cal (space view) counts for smoothing |
| QA_NFAIL_CAL_chan_missing | 16-bit integer | Channel (= 15) | Number of calibration failures per channel because channel is not implemented (HSB channel #1) |
| QA_NFAIL_CAL_other | 16-bit integer | Channel (= 15) | Number of calibration failures per channel for other reasons |

## Along-Track Data Fields

These fields appear once per scanline (GeoTrack times).

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| satheight | 32-bit floating-point | None | Satellite altitude at nadirTAI in km above reference ellipsoid (e.g. 725.2) |
| satroll | 32-bit floating-point | None | Satellite attitude roll angle at nadirTAI (-180.0 ... 180.0 angle about the +x (roll) ORB axis, +x axis is positively oriented in the direction of orbital flight completing an orthogonal triad with y and z.) |
| satpitch | 32-bit floating-point | None | Satellite attitude pitch angle at nadirTAI (-180.0 ... 180.0 angle about +y (pitch) ORB axis. +y axis is oriented normal to the orbit plane with the positive sense opposite to that of the orbit's angular momentum vector H.) |
| satyaw | 32-bit floating-point | None | Satellite attitude yaw angle at nadirTAI (-180.0 ... 180.0 angle about +z (yaw) axis. +z axis is positively oriented Earthward parallel to the satellite radius vector R from the spacecraft center of mass to the center of the Earth.) |
| satgeoqa | 32-bit unsigned integer | None | See Appendix D |
| glintgeoqa | 16-bit unsigned integer | None | See Appendix D |
| moongeoqa | 16-bit unsigned integer | None | See Appendix D |
| nadirTAI | 64-bit floating-point | None | TAI time at which instrument is nominally looking directly down. (between footprints 15 & 16 for AMSU or between footprints 45 & 46 for AIRS/Vis & HSB) (floating-point elapsed seconds since start of 1993) |
| sat_lat | 64-bit floating-point | None | Satellite geodetic latitude in degrees North (-90.0 ... 90.0) |
| sat_lon | 64-bit floating-point | None | Satellite geodetic longitude in degrees East (-180.0 ... 180.0) |
| scan_node_type | 8-bit integer | None | 'A' for ascending, 'D' for descending, 'E' when an error is encountered in trying to determine a value. |
| glintlat | 32-bit floating-point | None | Solar glint geodetic latitude in degrees North at nadirTAI (-90.0 ... 90.0) |
| glintlon | 32-bit floating-point | None | Solar glint geodetic longitude in degrees East at nadirTAI (-180.0 ... 180.0) |
| state1 | 32-bit integer | None | Data state for AMSU-A1: 0:Process, 1:Special, 2:Erroneous, 3:Missing |
| state2 | 32-bit | None | Data state for AMSU-A2: 0:Process, 1:Special, 2:Erroneous, 3:Missing |

| | | | |
|---|---|---|---|
| | integer | | (AMSU-A2 is AMSU-A channels 1 and 2) |
| qa_a11_primPRT | 8-bit unsigned integer | None | Receiver bitmap for AMSU-A1-1 primary PRT: Bit 0: (LSB, value 1) Failed bad value;<br>Bit 1: (value 2) Failed low limit test;<br>Bit 2: (value 4) Failed high limit test;<br>Bit 3: (value 8) Failed cross-scan test |
| qa_a11_secPRT | 8-bit unsigned integer | None | Receiver bitmap for AMSU-A1-1 secondary PRT (bits defined as for qa_11_primPRT) |
| qa_a12_primPRT | 8-bit unsigned integer | None | Receiver bitmap for AMSU-A1-2 primary PRT (bits defined as for qa_11_primPRT) |
| qa_a12_secPRT | 8-bit unsigned integer | None | Receiver bitmap for AMSU-A1-2 secondary PRT (bits defined as for qa_11_primPRT) |
| qa_a2_primPRT | 8-bit unsigned integer | None | Receiver bitmap for AMSU-A2 primary PRT (bits defined as for qa_11_primPRT) |
| qa_a2_secPRT | 8-bit unsigned integer | None | Receiver bitmap for AMSU-A2 secondary PRT (bits defined as for qa_11_primPRT) |
| qa_a11_wPRT_bad_val | 8-bit unsigned integer | None | Warm target bad values bitmap for AMSU-A1-1 PRTs: Bit 0: (LSB, value 1) problem with center PRT;<br>Bits 1-4: problem with PRTs 1-4 |
| qa_a11_wPRT_lo_lim | 8-bit unsigned integer | None | Warm target Low limit bitmap for AMSU-A1-1 PRTs (bits defined as for qa_a11_wPRT_bad_val) |
| qa_a11_wPRT_hi_lim | 8-bit unsigned integer | None | Warm target High limit bitmap for AMSU-A1-1 PRTs (bits defined as for qa_a11_wPRT_bad_val) |
| qa_a11_wPRT_in_scan | 8-bit unsigned integer | None | Warm target in-scan bitmap for AMSU-A1-1 PRTs (bits defined as for qa_a11_wPRT_bad_val) |
| qa_a11_wPRT_x_scan | 8-bit unsigned integer | None | Warm target cross-scan bitmap for AMSU-A1-1 PRTs (bits defined as for qa_a11_wPRT_bad_val) |
| qa_a12_wPRT_bad_val | 8-bit unsigned integer | None | Warm target bad values bitmap for AMSU-A1-2 PRTs: Bit 0: (LSB, value 1) problem with center PRT;<br>Bits 1-4: problem with PRTs 1-4 |
| qa_a12_wPRT_lo_lim | 8-bit unsigned integer | None | Warm target Low limit bitmap for AMSU-A1-2 PRTs (bits defined as for qa_a12_wPRT_bad_val) |
| qa_a12_wPRT_hi_lim | 8-bit unsigned integer | None | Warm target High limit bitmap for AMSU-A1-2 PRTs (bits defined as for qa_a12_wPRT_bad_val) |
| qa_a12_wPRT_in_scan | 8-bit unsigned integer | None | Warm target in-scan bitmap for AMSU-A1-2 PRTs (bits defined as for qa_a12_wPRT_bad_val) |
| qa_a12_wPRT_x_scan | 8-bit unsigned integer | None | Warm target cross-scan bitmap for AMSU-A1-2 PRTs (bits defined as for qa_a12_wPRT_bad_val) |
| qa_a2_wPRT_bad_val | 8-bit unsigned integer | None | Warm target bad values bitmap for AMSU-A2 PRTs: Bit 0: (LSB, value 1) problem with center PRT;<br>Bits 1-4: problem with PRTs 1-4 |
| qa_a2_wPRT_lo_lim | 8-bit unsigned integer | None | Warm target Low limit bitmap for AMSU-A2 PRTs (bits defined as for qa_a2_wPRT_bad_val) |
| qa_a2_wPRT_hi_lim | 8-bit unsigned integer | None | Warm target High limit bitmap for AMSU-A2 PRTs (bits defined as for qa_a2_wPRT_bad_val) |
| qa_a2_wPRT_in_scan | 8-bit unsigned integer | None | Warm target in-scan bitmap for AMSU-A2 PRTs (bits defined as for qa_a2_wPRT_bad_val) |

| | | | |
|---|---|---|---|
| qa_a2_wPRT_x_scan | 8-bit unsigned integer | None | Warm target cross-scan bitmap for AMSU-A2 PRTs (bits defined as for qa_a2_wPRT_bad_val) |
| qa_WC_bad_val | 16-bit unsigned integer | BBXTrack (= 2) | Warm target input counts bad values: Bits 0 (LSB)-14: problem with channels 1-15 |
| qa_WC_lo_lim | 16-bit unsigned integer | BBXTrack (= 2) | Warm target input counts Low limit: Bits 0 (LSB)-14: problem with channels 1-15 |
| qa_WC_hi_lim | 16-bit unsigned integer | BBXTrack (= 2) | Warm target input counts High limit: Bits 0 (LSB)-14: problem with channels 1-15 |
| qa_CC_bad_val | 16-bit unsigned integer | SpaceXTrack (= 2) | Cold cal input counts bad values: Bits 0 (LSB)-14: problem with channels 1-15 |
| qa_CC_lo_lim | 16-bit unsigned integer | SpaceXTrack (= 2) | Cold cal input counts Low limit: Bits 0 (LSB)-14: problem with channels 1-15 |
| qa_CC_hi_lim | 16-bit unsigned integer | SpaceXTrack (= 2) | Cold cal input counts High limit: Bits 0 (LSB)-14: problem with channels 1-15 |
| qa_CC_moon_flag | 16-bit unsigned integer | SpaceXTrack (= 2) | Cold cal input counts moon flag: Bits 0 (LSB)-14: problem with channels 1-15 |
| qa_calibration | 16-bit unsigned integer | Channel (= 15) | Calibration QA bitmap: Bit 0: (LSB, value 1) not in process state;<br>Bit 1: (value 2) no coef for reuse;<br>Bit 2: (value 4) Reference PRT;<br>Bit 3: (value 8) Warm Temp Cal;<br>Bit 4: (value 16) Cold Temp Cal;<br>Bit 5: (value 32) Warm Counts - no good counts;<br>Bit 6: (value 64) Warm Counts - in-scan dev;<br>Bit 7: (value 128) Warm Counts - smooth threshold;<br>Bit 8: (value 256) Cold Counts - no good counts;<br>Bit 9: (value 512) Cold Counts - in-scan dev;<br>Bit 10: (value 1024) Cold Counts - smooth threshold;<br>Bit 11: (value 2048) Failed - channel not implemented;<br>Bit 12: (value 4096) Other failure |
| cal_coef_a0 | 32-bit floating-point | Channel (= 15) | Calibration coefficients to convert raw counts to antenna temperature (K) |
| cal_coef_a0_err | 32-bit floating-point | Channel (= 15) | Error estimate for cal_coef_a0 (K) |
| cal_coef_a1 | 32-bit floating-point | Channel (= 15) | Calibration coefficients to convert raw counts to antenna temperature (K/count) |
| cal_coef_a1_err | 32-bit floating-point | Channel (= 15) | Error estimate for cal_coef_a1 (K/count) |
| cal_coef_a2 | 32-bit floating-point | Channel (= 15) | Calibration coefficients to convert raw counts to antenna temperature (K/count**2) |
| cal_coef_a2_err | 32-bit floating-point | Channel (= 15) | Error estimate for cal_coef_a2 (K/count**2) |
| bb_brightness | 32-bit floating-point | Channel (= 15) | Blackbody brightness temperature (Tbw) (K) |
| bb_brightness_err | 32-bit floating-point | Channel (= 15) | Blackbody brightness temperature error (delta-Tbw) (K) |
| spaceview_temp | 32-bit floating-point | Channel (= 15) | Spaceview brightness temperature (Tbc) (K) |
| spaceview_temp_err | 32-bit | Channel (= | Spaceview brightness temperature error (delta-Tbc) (K) |

| | | | |
|---|---|---|---|
| | floating-point | 15) | |
| cold_count | 32-bit floating-point | Channel (= 15) | Qual and averaged cold cal (space view) counts for this scanline (counts) |
| warm_count | 32-bit floating-point | Channel (= 15) | Qual and averaged warm cal (target view) counts for this scanline (counts) |
| smoothed_cold_count | 32-bit floating-point | Channel (= 15) | Smoothed cold cal counts for this scanline (counts) |
| smoothed_warm_count | 32-bit floating-point | Channel (= 15) | Smoothed warm cal counts for this scanline (counts) |
| a1_ColdCalPstion | 8-bit integer | None | AMSU-A1 Cold Calibration Position 1-4 (Binary 0-3) |
| a2_ColdCalPstion | 8-bit integer | None | AMSU-A2 Cold Calibration Position 1-4 (Binary 0-3) (AMSU-A2 is AMSU-A channels 1 and 2) |
| a1_PLO_Redundncy | 8-bit integer | None | AMSU-A1 PLO Redundancy, 1: default (PLO 2);<br>0: redundant (PLO 1) |
| a11_mux_temp_used | 8-bit integer | None | AMSU-A1-1 MUX Temperature use flag. (1: used MUX temperature for AMSU-A1 receiver temperature;<br>0: used RF shelf temperature) (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15) |
| a11_receiver_temp | 32-bit floating-point | None | AMSU-A1-1 receiver temperature used in calibration (MUX temperature or RF shelf temperature as specified by a11_mux_temp_used) (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15) (C) |
| a11_target_temp | 32-bit floating-point | None | AMSU-A1-1 target temperature used in calibration (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15) (C) |
| a12_mux_temp_used | 8-bit integer | None | AMSU-A1-2 MUX Temperature use flag. (1: used MUX temperature for AMSU-A1 receiver temperature;<br>0: used RF shelf temperature) (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8) |
| a12_receiver_temp | 32-bit floating-point | None | AMSU-A1-2 receiver temperature used in calibration (MUX temperature or RF shelf temperature as specified by a12_mux_temp_used) (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8) (C) |
| a12_target_temp | 32-bit floating-point | None | AMSU-A1-2 target temperature used in calibration (AMSU-A1-2 is AMSU-A channels 3, 4, 5, and 8) (C) |
| a2_diplexer_temp_used | 8-bit integer | None | AMSU-A2 diplexer Temperature use flag. (1: used diplexer temperature for AMSU-A2 receiver temperature;<br>0: used RF shelf temperature) (AMSU-A2 is AMSU-A channels 1 and 2) |
| a2_receiver_temp | 32-bit floating-point | None | AMSU-A2 receiver temperature used in calibration (diplexer temperature or RF shelf temperature as specified by a2_diplexer_temp_used) (AMSU-A2 is AMSU-A channels 1 and 2) (C) |
| a2_target_temp | 32-bit floating-point | None | AMSU-A2 target temperature used in calibration (AMSU-A2 is AMSU-A channels 1 and 2) (C) |
| qa_scanline | 8-bit unsigned integer | None | Scanline bitmap for AMSU-A: Bit 0: (LSB, value 1) Sun glint in this scanline;<br>Bit 1: (value 2) Coastal crossing in this scanline;<br>Bit 2: (value 4) Some channels had excessive NeDT estimate;<br>Bit 3: (value 8) Near sidelobe correction applied |
| qa_receiver_a11 | 8-bit unsigned integer | None | Receiver bitmap for AMSU-A1-1 (AMSU-A1-1 is AMSU-A channels 6, 7, 9-15): Bit 0: (LSB, value 1) Calibration was not derived, due to the instrument mode;<br>Bit 1: (value 2) Calibration was not derived, due to bad or missing PRT values;<br>Bit 2: (value 4) This scanline was calibrated, but the moon was in the space view;<br>Bit 3: (value 8) This scanline was calibrated, but there was a space view scan position err;<br>Bit 4: (value 16) This scanline was calibrated, but there was a blackbody scan position error;<br>Bit 5: (value 32) This scanline was calibrated, but some PRT values were |

| | | | |
|---|---|---|---|
| | | | bad or marginal;<br>Bit 6: (value 64) This scanline was calibrated, but there was a data gap;<br>Bit 7: (value 128) Some channels were not calibrated |
| qa_receiver_a12 | 8-bit unsigned integer | None | Receiver bitmap for AMSU-A1-2:Same fields as defined for qa_receiver_a11 |
| qa_receiver_a2 | 8-bit unsigned integer | None | Receiver bitmap for AMSU-A2:Same fields as defined for qa_receiver_a11 |
| qa_channel | 8-bit unsigned integer | Channel (= 15) | Channel bitmap for AMSU-A: Bit 0: (LSB, value 1) All space view counts were bad for this channel and scanline;<br>Bit 1: (value 2) Space view counts were marginal for this channel and scanline;<br>Bit 2: (value 4) Space view counts could not be smoothed;<br>Bit 3: (value 8) All blackbody counts were bad for this channel and scanline;<br>Bit 4: (value 16) Blackbody counts were marginal for this channel and scanline;<br>Bit 5: (value 32) Blackbody counts could not be smoothed;<br>Bit 6: (value 64) Unable to calculate calibration coefficients for this scanline, most recent valid coefficients used instead;<br>Bit 7: (value 128) Excessive NeDT estimated |

## Full Swath Data Fields

These fields appear for every footprint of every scanline in the granule (GeoTrack * GeoXTrack times).

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| scanang | 32-bit floating-point | None | Scanning angle of AMSU-A instrument with respect to the AMSU-A Instrument for this footprint (-180.0 ... 180.0, negative at start of scan, 0 at nadir) |
| ftptgeoqa | 32-bit unsigned integer | None | See Appendix D |
| zengeoqa | 16-bit unsigned integer | None | See Appendix D |
| demgeoqa | 16-bit unsigned integer | None | See Appendix D |
| satzen | 32-bit floating-point | None | Spacecraft zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| satazi | 32-bit floating-point | None | Spacecraft azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| solzen | 32-bit floating-point | None | Solar zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| solazi | 32-bit floating-point | None | Solar azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| sun_glint_distance | 16-bit integer | None | Distance (km) from footprint center to location of the sun glint (-9999 for unknown, 30000 for no glint visible because spacecraft is in Earth's shadow) |
| topog | 32-bit floating-point | None | Mean topography in meters above reference ellipsoid |
| topog_err | 32-bit floating-point | None | Error estimate for topog |
| landFrac | 32-bit floating-point | None | Fraction of spot that is land (0.0 ... 1.0) |
| landFrac_err | 32-bit floating-point | None | Error estimate for landFrac |
| antenna_temp | 32-bit floating-point | Channel (= 15) | Raw antenna temperature in Kelvins |
| brightness_temp | 32-bit | Channel (= | Antenna temperatures, with an empirically derived correction applied to |

| | | | |
|---|---|---|---|
| | floating-point | 15) | compensate for scan-position dependent bias. This correction is derived from AIRS retrievals. (K) |
| brightness_temp_err | 32-bit floating-point | Channel (= 15) | Uncertainty in empirically derived brightness_temp bias correction, excluding radiometer noise. (K) |
| bt_sidelobe_corr | 32-bit floating-point | Channel (= 15) | Correction to raw antenna temperature to give brightness_temp. This correction accounts for near- and far- sidelobe effects. (K) |

## Special AIRS Types

AIRS works around the lack of support for records in HDF-EOS Swath by grouping related fields into pseudo-records. HDF-EOS fieldnames are generated by concatenating the pseudo-record name with the subfield name, putting a "." character in between. Since these record types do not exist at the HDF-EOS swath level, reading subfield "min" of AIRS field "QA_bb_PRT_a11" involves reading HDF-EOS Swath field "QA_bb_PRT_a11.min".

Limited Engineering Struct: This type is used for engineering data fields for which there are known "yellow" limits.

| Field Name | Type | Explanation |
|---|---|---|
| min | 32-bit floating-point | Minimum value field takes on in granule (not valid when num_in = 0) |
| max | 32-bit floating-point | Maximum value field takes on in granule (not valid when num_in = 0) |
| mean | 32-bit floating-point | Mean of values field takes on in granule (not valid when num_in = 0) |
| dev | 32-bit floating-point | Standard Deviation of values field takes on in granule (not valid when num_in < 2) |
| num_in | 32-bit integer | Count of in-range values field takes on in granule |
| num_lo | 32-bit integer | Count of out-of-range low values field takes on in granule |
| num_hi | 32-bit integer | Count of out-of-range high values field takes on in granule |
| num_bad | 32-bit integer | Count of occassions on which field takes on invalid flag value (-9999) in granule |
| range_min | 32-bit floating-point | Minimum in-range value. |
| range_max | 32-bit floating-point | Maximum in-range value. |
| missing | 8-bit integer | Missing limits flags. Bit 0 (LSB) is 1 when yellow low (range_min) limit is missing;<br>Bit 1 is high when yellow high (range_max) limit is missing;<br>other bits unused, set to 0. |
| max_track | 32-bit integer | GeoTrack index (counting from 1) where max was found |
| max_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where max was found |
| min_track | 32-bit integer | GeoTrack index (counting from 1) where min was found |
| min_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where min was found |

Unlimited Engineering Struct: This type is used for engineering data fields for which there are NOT known "yellow" limits.

| Field Name | Type | Explanation |
|---|---|---|
| min | 32-bit floating-point | Minimum value field takes on in granule (not valid when num_in = 0) |
| max | 32-bit floating-point | Maximum value field takes on in granule (not valid when num_in = 0) |
| mean | 32-bit floating-point | Mean of values field takes on in granule (not valid when num_in = 0) |
| dev | 32-bit floating-point | Standard Deviation of values field takes on in granule (not valid when num_in < 2) |
| num | 32-bit integer | Count of occurrences of field in granule (not including those counted in num_bad) |
| num_bad | 32-bit integer | Count of occassions on which field takes on invalid flag value (-9999) in granule |
| max_track | 32-bit integer | GeoTrack index (counting from 1) where max was found |
| max_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where max was found |
| min_track | 32-bit integer | GeoTrack index (counting from 1) where min was found |
| min_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where min was found |

Reference PRT counts: This type provides counts of rejection due to each rejection criterion for reference PRTs for MW instruments.

| Field Name | Type | Explanation |
|---|---|---|
| bad_value | 16-bit integer | Bad value |
| lo_lim | 16-bit integer | Low limit |
| hi_lim | 16-bit integer | High limit |
| x_scan | 16-bit integer | Large cross-scan deviation |

Warm PRT counts: This type provides counts of rejection due to each rejection criterion for warm target PRTs for MW instruments.

| Field Name | Type | Explanation |
|---|---|---|
| bad_value | 16-bit integer | Bad value |
| lo_lim | 16-bit integer | Low limit |
| hi_lim | 16-bit integer | High limit |
| in_scan | 16-bit integer | Large within-scan deviation |
| x_scan | 16-bit integer | Large cross-scan deviation |

# A1-7. L1B HSB Interface Specification

Interface Specification Version 5.0.14.0
2007-04-11

ESDT ShortName = "AIRHBRAD"

Swath Name = "L1B_HSB"

Level = "level1B"

# Footprints = 90

# scanlines per scanset = 3

## Dimensions

These fields define all dimensions that can be used for HDF-EOS swath fields.

The names "GeoTrack" and "GeoXTrack" have a special meaning for this document: "Cross-Track" data fields have a hidden dimension of "GeoXTrack"; "Along-Track" data fields have a hidden dimension of "GeoTrack"; "Full Swath" data fields have hidden dimensions of both "GeoTrack" and "GeoXTrack".

| Name | Value | Explanation |
|---|---|---|
| GeoXTrack | 90 | Dimension across track for footprint positions. Same as number of footprints per scanline. -- starting at the left and increasing towards the right as you look along the satellite's path |
| GeoTrack | # of scan lines in swath | Dimension along track for footprint positions. Same as number of scanlines in granule. Parallel to the satellite's path, increasing with time. (Nominally 45 for Level-2, AMSU-A, and AIRS/Vis low-rate engineering;<br>135 for AIRS/Vis and HSB high-rate quantities) |
| Channel | 5 | Dimension of channel array (Channel 1: Deleted 89.0 GHz channel: always invalid;<br>Ch 2: 150.0 GHz;<br>Ch 3: f0 +/- 1.0 GHz;<br>Ch 4: f0 +/- 3.0 GHz;<br>Ch 5: f0 +/- 7.0 GHz (f0 = 183.31 GHz)) |
| CalXTrack | 8 | Dimension "across" track for calibration footprint positions. Same as number of calibration footprints per scanline. (NUM_FOOTPRINTS_HSB_CALIB) (Footprints are ordered: 1-4: spaceviews;<br>5-8: blackbody radiometric calibration source) |
| SpaceXTrack | 4 | Dimension "across" track for spaceview calibration footprint positions in order of observation time. (NUM_FOOTPRINTS_HSB_SPACE) |
| BBXTrack | 4 | Dimension "across" track for blackbody calibration footprint positions in order of observation time. (NUM_FOOTPRINTS_HSB_BB) |
| WarmPRT | 7 | Number of PRTs measuring warm target |

## Geolocation Fields

These fields appear for every footprint (GeoTrack * GeoXTrack times) and correspond to footprint center coordinates and "shutter" time.

| Name | Explanation |
|---|---|
| Latitude | Footprint boresight geodetic Latitude in degrees North (-90.0 ... 90.0) |

| | |
|---|---|
| Longitude | Footprint boresight geodetic Longitude in degrees East (-180.0 ... 180.0) |
| Time | Footprint "shutter" TAI Time: floating-point elapsed seconds since Jan 1, 1993 |

## Attributes

These fields appear only once per granule and use the HDF-EOS "Attribute" interface.

| Name | Type | Explanation |
|---|---|---|
| processing_level | string of 8-bit characters | Zero-terminated character string denoting processing level ("level1B") |
| instrument | string of 8-bit characters | Zero-terminated character string denoting instrument ("HSB") |
| DayNightFlag | string of 8-bit characters | Zero-terminated character string set to "Night" when the subsatellite points at the beginning and end of a granule are both experiencing night according to the "civil twilight" standard (center of refracted sun is below the horizon). It is set to "Day" when both are experiencing day, and "Both" when one is experiencing day and the other night. "NA" is used when a determination cannot be made. |
| AutomaticQAFlag | string of 8-bit characters | Zero-terminated character string denoting granule data quality: (Always "Passed", "Failed", or "Suspect") |
| NumTotalData | 32-bit integer | Total number of expected channels * scene FOVs |
| NumProcessData | 32-bit integer | Number of channels * scene FOVs which are present and can be processed routinely (state = 0) |
| NumSpecialData | 32-bit integer | Number of channels * scene FOVs which are present and can be processed only as a special test (state = 1) |
| NumBadData | 32-bit integer | Number of channels * scene FOVs which are present but cannot be processed (state = 2) |
| NumMissingData | 32-bit integer | Number of expected channels * scene FOVs which are not present (state = 3) |
| NumLandSurface | 32-bit integer | Number of scene footprints for which the surface is more than 90% land |
| NumOceanSurface | 32-bit integer | Number of scene footprints for which the surface is less than 10% land |
| node_type | string of 8-bit characters | Zero-terminated character string denoting whether granule is ascending, descending, or pole-crossing: ("Ascending" and "Descending" for entirely ascending or entirely descending granules, or "NorthPole" or "SouthPole" for pole-crossing granules. "NA" when determination cannot be made.) |
| start_year | 32-bit integer | Year in which granule started, UTC (e.g. 1999) |
| start_month | 32-bit integer | Month in which granule started, UTC (1 ... 12) |
| start_day | 32-bit integer | Day of month in which granule started, UTC (1 ... 31) |
| start_hour | 32-bit integer | Hour of day in which granule started, UTC (0 ... 23) |
| start_minute | 32-bit integer | Minute of hour in which granule started, UTC (0 ... 59) |
| start_sec | 32-bit floating-point | Second of minute in which granule started, UTC (0.0 ... 59.0) |
| start_orbit | 32-bit integer | Orbit number of mission in which granule started |
| end_orbit | 32-bit integer | Orbit number of mission in which granule ended |
| orbit_path | 32-bit integer | Orbit path of start orbit (1 ... 233 as defined by EOS project) |
| start_orbit_row | 32-bit integer | Orbit row at start of granule (1 ... 248 as defined by EOS project) |
| end_orbit_row | 32-bit integer | Orbit row at end of granule (1 ... 248 as defined by EOS project) |
| granule_number | 32-bit integer | Number of granule within day (1 ... 240) |
| num_scansets | 32-bit integer | Number of scansets in granule (1 ... 45) |
| num_scanlines | 32-bit integer | Number of scanlines in granule (3 * num_scansets) |
| start_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees North (-90.0 ... 90.0) |
| start_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees East (-180.0 ... 180.0) |
| start_Time | 64-bit floating-point | TAI Time at start of granule (floating-point elapsed seconds since start of 1993) |
| end_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees North (-90.0 ... 90.0) |

| | | |
|---|---|---|
| end_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees East (-180.0 ... 180.0) |
| end_Time | 64-bit floating-point | TAI Time at end of granule (floating-point elapsed seconds since start of 1993) |
| eq_x_longitude | 32-bit floating-point | Longitude of spacecraft at southward equator crossing nearest granule start in degrees East (-180.0 ... 180.0) |
| eq_x_tai | 64-bit floating-point | Time of eq_x_longitude in TAI units (floating-point elapsed seconds since start of 1993) |
| orbitgeoqa | 32-bit unsigned integer | See Appendix D |
| num_satgeoqa | 16-bit integer | Number of scans with problems in satgeoqa |
| num_glintgeoqa | 16-bit integer | Number of scans with problems in glintgeoqa |
| num_moongeoqa | 16-bit integer | Number of scans with problems in moongeoqa |
| num_ftptgeoqa | 16-bit integer | Number of footprints with problems in ftptgeoqa |
| num_zengeoqa | 16-bit integer | Number of footprints with problems in zengeoqa |
| num_demgeoqa | 16-bit integer | Number of footprints with problems in demgeoqa |
| num_fpe | 16-bit integer | Number of floating point errors |
| LonGranuleCen | 16-bit integer | Geodetic Longitude of the center of the granule in degrees East (-180 ... 180) |
| LatGranuleCen | 16-bit integer | Geodetic Latitude of the center of the granule in degrees North (-90 ... 90) |
| LocTimeGranuleCen | 16-bit integer | Local solar time at the center of the granule in minutes past midnight (0 ... 1439) |
| num_scanlines_not_norm_mode | 32-bit integer | Number of scanlines not in Process state |
| num_missing_scanlines | 32-bit integer | Number of scanlines with state = missing |
| num_data_gaps | 32-bit integer | Number of blocks of scanlines where State is not Process |
| num_instr_mode_changes | 32-bit integer | Number of operational instrument mode changes |
| num_scanlines_rec_cal_prob | 32-bit integer | Number of scanlines with non-zero qa_receiver |
| num_scanlines_sig_coast_xing | 32-bit integer | Number of scanlines with qa_scanline coast crossing bit set |
| num_scanlines_sig_sun_glint | 32-bit integer | Number of scanlines with qa_scanline sun glint bit set |
| MoonInViewMWCount | 32-bit integer | Number of scanlines in granule with the moon in the HSB space view |
| QA_bb_PRT | Limited Engineering Struct (see below) | Blackbody PRT temperature summary QA (C) |
| QA_rec_PRT | Limited Engineering Struct (see below) | Receiver PRT temperature summary QA (C) |
| granules_present | string of 8-bit characters | Zero-terminated character string denoting which adjacent granules were available for smoothing ("All" for both previous & next, "Prev" for previous but not next, "Next" for next but not previous, "None" for neither previous nor next) |

## Per-Granule Data Fields

These fields appear only once per granule and use the HDF-EOS "Field" interface.

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| center_freq | 32-bit floating-point | Channel (= 5) | Channel Center frequency (GHz) |
| IF_offset_1 | 32-bit floating-point | Channel (= 5) | Offset of first intermediate frequency stage (MHz) (zero for no mixing) |
| IF_offset_2 | 32-bit floating-point | Channel (= 5) | Offset of second intermediate frequency stage (MHz) (zero for no second mixing) |
| bandwidth | 32-bit floating-point | Channel (= 5) | Bandwidth of sum of 1, 2, or 4 channels (MHz) |
| num_calibrated_scanlines | 32-bit integer | Channel (= 5) | Number of scanlines that had calibration coefs applied |
| num_scanlines_ch_cal_problems | 32-bit integer | Channel (= 5) | Number of scanlines with non-zero |

| | | | |
|---|---|---|---|
| | | | qa_channel |
| bb_signals | Unlimited Engineering Struct (see below) | BBXTrack (= 4) * Channel (= 5) | Statistics on blackbody calibration signals (data numbers with offset subtracted) |
| space_signals | Unlimited Engineering Struct (see below) | SpaceXTrack (= 4) * Channel (= 5) | Statistics on spaceview calibration signals (data numbers with offset subtracted) |
| gain_stats | Unlimited Engineering Struct (see below) | Channel (= 5) | Statistics on gains (count/K) |
| NeDT | 32-bit floating-point | Channel (= 5) | Instrument noise level estimated from warm count scatter (K) |
| QA_unfiltered_scene_count | Unlimited Engineering Struct (see below) | GeoXTrack (= 90) * Channel (= 5) | Per footprint position raw scene count summary QA |
| QA_unfiltered_BB_count | Unlimited Engineering Struct (see below) | BBXTrack (= 4) * Channel (= 5) | Per BB footprint position raw warm count summary QA (unfiltered) |
| QA_unfiltered_space_count | Unlimited Engineering Struct (see below) | SpaceXTrack (= 4) * Channel (= 5) | Per space footprint position raw cold count summary QA (unfiltered) |
| QA_cal_coef_a0 | Unlimited Engineering Struct (see below) | Channel (= 5) | Calibration coefficient a0 summary QA (K) |
| QA_cal_coef_a1 | Unlimited Engineering Struct (see below) | Channel (= 5) | Calibration coefficient a1 summary QA (K/count) |
| QA_cal_coef_a2 | Unlimited Engineering Struct (see below) | Channel (= 5) | Calibration coefficient a2 summary QA (K/count**2) |
| QA_bb_raw_noise_counts | Unlimited Engineering Struct (see below) | Channel (= 5) | Summary QA on differences between warm cal counts, DT=ABS(T1-T2)/SQRT(2) |
| QA_sv_raw_noise_counts | Unlimited Engineering Struct (see below) | Channel (= 5) | Summary QA on differences between cold cal counts, DT=ABS(T1-T2)/SQRT(2) |

## Along-Track Data Fields

These fields appear once per scanline (GeoTrack times).

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| satheight | 32-bit floating-point | None | Satellite altitude at nadirTAI in km above reference ellipsoid (e.g. 725.2) |
| satroll | 32-bit floating-point | None | Satellite attitude roll angle at nadirTAI (-180.0 ... 180.0 angle about the +x (roll) ORB axis, +x axis is positively oriented in the direction of orbital flight completing an orthogonal triad with y and z.) |
| satpitch | 32-bit floating-point | None | Satellite attitude pitch angle at nadirTAI (-180.0 ... 180.0 angle about +y (pitch) ORB axis. +y axis is oriented normal to the orbit plane with the positive sense opposite to that of the orbit's angular momentum vector H.) |
| satyaw | 32-bit floating-point | None | Satellite attitude yaw angle at nadirTAI (-180.0 ... 180.0 angle about +z (yaw) axis. +z axis is positively oriented Earthward parallel to the satellite radius vector R from the spacecraft center of mass to the center of the Earth.) |
| satgeoqa | 32-bit unsigned integer | None | See Appendix D |
| glintgeoqa | 16-bit unsigned integer | None | See Appendix D |
| moongeoqa | 16-bit unsigned integer | None | See Appendix D |
| nadirTAI | 64-bit floating-point | None | TAI time at which instrument is nominally looking directly down. (between footprints 15 & 16 for AMSU or between footprints 45 & 46 for AIRS/Vis & HSB) (floating-point elapsed seconds since start of 1993) |
| sat_lat | 64-bit floating-point | None | Satellite geodetic latitude in degrees North (-90.0 ... 90.0) |

| | | | |
|---|---|---|---|
| sat_lon | 64-bit floating-point | None | Satellite geodetic longitude in degrees East (-180.0 ... 180.0) |
| scan_node_type | 8-bit integer | None | 'A' for ascending, 'D' for descending, 'E' when an error is encountered in trying to determine a value. |
| glintlat | 32-bit floating-point | None | Solar glint geodetic latitude in degrees North at nadirTAI (-90.0 ... 90.0) |
| glintlon | 32-bit floating-point | None | Solar glint geodetic longitude in degrees East at nadirTAI (-180.0 ... 180.0) |
| state | 32-bit integer | None | Data state: 0:Process, 1:Special, 2:Erroneous, 3:Missing |
| cal_coef_a0 | 32-bit floating-point | Channel (= 5) | Calibration coefficients to convert raw counts to antenna temperature (K) |
| cal_coef_a0_err | 32-bit floating-point | Channel (= 5) | Error estimate for cal_coef_a0 (K) |
| cal_coef_a1 | 32-bit floating-point | Channel (= 5) | Calibration coefficients to convert raw counts to antenna temperature (K/count) |
| cal_coef_a1_err | 32-bit floating-point | Channel (= 5) | Error estimate for cal_coef_a1 (K/count) |
| cal_coef_a2 | 32-bit floating-point | Channel (= 5) | Calibration coefficients to convert raw counts to antenna temperature (K/count**2) |
| cal_coef_a2_err | 32-bit floating-point | Channel (= 5) | Error estimate for cal_coef_a2 (K/count**2) |
| SpacViewSelct | 8-bit integer | None | Space View Selected |
| mixer_17_temp_used | 8-bit integer | None | Mixer 17 Temperature use flag. (1: used mixer 17 temperature for receiver temperature;<br>0: used mixer 18/19/20 temperature) |
| receiver_temp | 32-bit floating-point | None | Receiver temperature used in calibration (mixer 17 temperature or mixer 18/19/20 temperature as specified by mixer_17_temp_used) (C) |
| target_temp | 32-bit floating-point | None | HSB target temperature used in calibration (C) |
| qa_scanline | 8-bit unsigned integer | None | Scanline bitmap for HSB: Bit 0: (LSB, value 1) Sun glint in this scanline;<br>Bit 1: (value 2) Coastal crossing in this scanline;<br>Bit 2: (value 4) Some channels had excessive NeDT estimate;<br>Bit 3: (value 8) Near sidelobe correction applied |
| qa_receiver | 8-bit unsigned integer | None | Receiver bitmap for HSB: Bit 0: (LSB, value 1) Calibration was not derived, due to the instrument mode;<br>Bit 1: (value 2) Calibration was not derived, due to bad or missing PRT values;<br>Bit 2: (value 4) This scanline was calibrated, but the moon was in the space view;<br>Bit 3: (value 8) This scanline was calibrated, but there was a space view scan position err;<br>Bit 4: (value 16) This scanline was calibrated, but there was a blackbody scan position error;<br>Bit 5: (value 32) This scanline was calibrated, but some PRT values were bad or marginal;<br>Bit 6: (value 64) This scanline was calibrated, but there was a data gap;<br>Bit 7: (value 128) Some channels were not calibrated |
| qa_channel | 8-bit unsigned integer | Channel (= 5) | Channel bitmap for HSB: Bit 0: (LSB, value 1) All space view counts were bad for this channel and scanline;<br>Bit 1: (value 2) Space view counts were marginal for this channel and scanline;<br>Bit 2: (value 4) Space view counts could not be smoothed;<br>Bit 3: (value 8) All blackbody counts were bad for this channel and scanline;<br>Bit 4: (value 16) Blackbody counts were marginal for this channel and scanline;<br>Bit 5: (value 32) Blackbody counts could not be smoothed;<br>Bit 6: (value 64) Most recent calibration coefficients used;<br>Bit 7: (value 128) Excessive NeDT estimated |

## Full Swath Data Fields

These fields appear for every footprint of every scanline in the granule (GeoTrack * GeoXTrack times).

| Name | Type | Extra | Explanation |
|---|---|---|---|

| | | Dimensions | |
|---|---|---|---|
| scanang | 32-bit floating-point | None | Scanning angle of HSB instrument with respect to the HSB instrument for this footprint (-180.0 ... 180.0, negative at start of scan, 0 at nadir) |
| ftptgeoqa | 32-bit unsigned integer | None | See Appendix D |
| zengeoqa | 16-bit unsigned integer | None | See Appendix D |
| demgeoqa | 16-bit unsigned integer | None | See Appendix D |
| satzen | 32-bit floating-point | None | Spacecraft zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| satazi | 32-bit floating-point | None | Spacecraft azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| solzen | 32-bit floating-point | None | Solar zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| solazi | 32-bit floating-point | None | Solar azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| sun_glint_distance | 16-bit integer | None | Distance (km) from footprint center to location of the sun glint (-9999 for unknown, 30000 for no glint visible because spacecraft is in Earth's shadow) |
| topog | 32-bit floating-point | None | Mean topography in meters above reference ellipsoid |
| topog_err | 32-bit floating-point | None | Error estimate for topog |
| landFrac | 32-bit floating-point | None | Fraction of spot that is land (0.0 ... 1.0) |
| landFrac_err | 32-bit floating-point | None | Error estimate for landFrac |
| antenna_temp | 32-bit floating-point | Channel (= 5) | Raw antenna temperature in Kelvins |
| brightness_temp | 32-bit floating-point | Channel (= 5) | Brightness temperature. Same as antenna_temp because sidelobe correction is small and ground truth is less known for water vapor. (K) |
| brightness_temp_err | 32-bit floating-point | Channel (= 5) | Uncertainty in empirically derived brightness_temp bias correction, excluding radiometer noise. (K) |

## Special AIRS Types

AIRS works around the lack of support for records in HDF-EOS Swath by grouping related fields into pseudo-records. HDF-EOS fieldnames are generated by concatenating the pseudo-record name with the subfield name, putting a "." character in between. Since these record types do not exist at the HDF-EOS swath level, reading subfield "min" of AIRS field "QA_bb_PRT" involves reading HDF-EOS Swath field "QA_bb_PRT.min".

Limited Engineering Struct: This type is used for engineering data fields for which there are known "yellow" limits.

| Field Name | Type | Explanation |
|---|---|---|
| min | 32-bit floating-point | Minimum value field takes on in granule (not valid when num_in = 0) |
| max | 32-bit floating-point | Maximum value field takes on in granule (not valid when num_in = 0) |
| mean | 32-bit floating-point | Mean of values field takes on in granule (not valid when num_in = 0) |
| dev | 32-bit floating-point | Standard Deviation of values field takes on in granule (not valid when num_in < 2) |
| num_in | 32-bit integer | Count of in-range values field takes on in granule |
| num_lo | 32-bit integer | Count of out-of-range low values field takes on in granule |

| | | |
|---|---|---|
| num_hi | 32-bit integer | Count of out-of-range high values field takes on in granule |
| num_bad | 32-bit integer | Count of occassions on which field takes on invalid flag value (-9999) in granule |
| range_min | 32-bit floating-point | Minimum in-range value. |
| range_max | 32-bit floating-point | Maximum in-range value. |
| missing | 8-bit integer | Missing limits flags. Bit 0 (LSB) is 1 when yellow low (range_min) limit is missing;<br>Bit 1 is high when yellow high (range_max) limit is missing;<br>other bits unused, set to 0. |
| max_track | 32-bit integer | GeoTrack index (counting from 1) where max was found |
| max_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where max was found |
| min_track | 32-bit integer | GeoTrack index (counting from 1) where min was found |
| min_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where min was found |

Unlimited Engineering Struct: This type is used for engineering data fields for which there are NOT known "yellow" limits.

| Field Name | Type | Explanation |
|---|---|---|
| min | 32-bit floating-point | Minimum value field takes on in granule (not valid when num = 0) |
| max | 32-bit floating-point | Maximum value field takes on in granule (not valid when num = 0) |
| mean | 32-bit floating-point | Mean of values field takes on in granule (not valid when num = 0) |
| dev | 32-bit floating-point | Standard Deviation of values field takes on in granule (not valid when num < 2) |
| num | 32-bit integer | Count of occurrences of field in granule (not including those counted in num_bad) |
| num_bad | 32-bit integer | Count of occassions on which field takes on invalid flag value (-9999) in granule |
| max_track | 32-bit integer | GeoTrack index (counting from 1) where max was found |
| max_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where max was found |
| min_track | 32-bit integer | GeoTrack index (counting from 1) where min was found |
| min_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where min was found |

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# A1-8. L1B HSB QA Interface Specification

Interface Specification Version 5.0.14.0
2007-04-11

ESDT ShortName = "AIRHBQAP"

Swath Name = "L1B_HSB_QASup"

Level = "level1B"

# Footprints = 90

# scanlines per scanset = 3

## Dimensions

These fields define all dimensions that can be used for HDF-EOS swath fields.

The names "GeoTrack" and "GeoXTrack" have a special meaning for this document: "Cross-Track" data fields have a hidden dimension of "GeoXTrack"; "Along-Track" data fields have a hidden dimension of "GeoTrack"; "Full Swath" data fields have hidden dimensions of both "GeoTrack" and "GeoXTrack".

| Name | Value | Explanation |
|---|---|---|
| GeoXTrack | 90 | Dimension across track for footprint positions. Same as number of footprints per scanline. -- starting at the left and increasing towards the right as you look along the satellite's path |
| GeoTrack | # of scan lines in swath | Dimension along track for footprint positions. Same as number of scanlines in granule. Parallel to the satellite's path, increasing with time. (Nominally 45 for Level-2, AMSU-A, and AIRS/Vis low-rate engineering;<br>135 for AIRS/Vis and HSB high-rate quantities) |
| Channel | 5 | Dimension of channel array (Channel 1: Deleted 89.0 GHz channel: always invalid;<br>Ch 2: 150.0 GHz;<br>Ch 3: f0 +/- 1.0 GHz;<br>Ch 4: f0 +/- 3.0 GHz;<br>Ch 5: f0 +/- 7.0 GHz (f0 = 183.31 GHz)) |
| CalXTrack | 8 | Dimension "across" track for calibration footprint positions. Same as number of calibration footprints per scanline. (NUM_FOOTPRINTS_HSB_CALIB) (Footprints are ordered: 1-4: spaceviews;<br>5-8: blackbody radiometric calibration source) |
| SpaceXTrack | 4 | Dimension "across" track for spaceview calibration footprint positions in order of observation time. (NUM_FOOTPRINTS_HSB_SPACE) |
| BBXTrack | 4 | Dimension "across" track for blackbody calibration footprint positions in order of observation time. (NUM_FOOTPRINTS_HSB_BB) |
| WarmPRT | 7 | Number of PRTs measuring warm target |

## Geolocation Fields

These fields appear for every footprint (GeoTrack * GeoXTrack times) and correspond to footprint center coordinates and "shutter" time.

| Name | Explanation |
|---|---|
| Latitude | Footprint boresight geodetic Latitude in degrees North (-90.0 ... 90.0) |

| | |
|---|---|
| Longitude | Footprint boresight geodetic Longitude in degrees East (-180.0 ... 180.0) |
| Time | Footprint "shutter" TAI Time: floating-point elapsed seconds since Jan 1, 1993 |

## Attributes

These fields appear only once per granule and use the HDF-EOS "Attribute" interface.

| Name | Type | Explanation |
|---|---|---|
| processing_level | string of 8-bit characters | Zero-terminated character string denoting processing level ("level1B") |
| instrument | string of 8-bit characters | Zero-terminated character string denoting instrument ("HSB") |
| DayNightFlag | string of 8-bit characters | Zero-terminated character string set to "Night" when the subsatellite points at the beginning and end of a granule are both experiencing night according to the "civil twilight" standard (center of refracted sun is below the horizon). It is set to "Day" when both are experiencing day, and "Both" when one is experiencing day and the other night. "NA" is used when a determination cannot be made. |
| AutomaticQAFlag | string of 8-bit characters | Zero-terminated character string denoting granule data quality: (Always "Passed", "Failed", or "Suspect") |
| NumTotalData | 32-bit integer | Total number of expected channels * scene FOVs |
| NumProcessData | 32-bit integer | Number of channels * scene FOVs which are present and can be processed routinely (state = 0) |
| NumSpecialData | 32-bit integer | Number of channels * scene FOVs which are present and can be processed only as a special test (state = 1) |
| NumBadData | 32-bit integer | Number of channels * scene FOVs which are present but cannot be processed (state = 2) |
| NumMissingData | 32-bit integer | Number of expected channels * scene FOVs which are not present (state = 3) |
| NumLandSurface | 32-bit integer | Number of scene footprints for which the surface is more than 90% land |
| NumOceanSurface | 32-bit integer | Number of scene footprints for which the surface is less than 10% land |
| node_type | string of 8-bit characters | Zero-terminated character string denoting whether granule is ascending, descending, or pole-crossing: ("Ascending" and "Descending" for entirely ascending or entirely descending granules, or "NorthPole" or "SouthPole" for pole-crossing granules. "NA" when determination cannot be made.) |
| start_year | 32-bit integer | Year in which granule started, UTC (e.g. 1999) |
| start_month | 32-bit integer | Month in which granule started, UTC (1 ... 12) |
| start_day | 32-bit integer | Day of month in which granule started, UTC (1 ... 31) |
| start_hour | 32-bit integer | Hour of day in which granule started, UTC (0 ... 23) |
| start_minute | 32-bit integer | Minute of hour in which granule started, UTC (0 ... 59) |
| start_sec | 32-bit floating-point | Second of minute in which granule started, UTC (0.0 ... 59.0) |
| start_orbit | 32-bit integer | Orbit number of mission in which granule started |
| end_orbit | 32-bit integer | Orbit number of mission in which granule ended |
| orbit_path | 32-bit integer | Orbit path of start orbit (1 ... 233 as defined by EOS project) |
| start_orbit_row | 32-bit integer | Orbit row at start of granule (1 ... 248 as defined by EOS project) |
| end_orbit_row | 32-bit integer | Orbit row at end of granule (1 ... 248 as defined by EOS project) |
| granule_number | 32-bit integer | Number of granule within day (1 ... 240) |
| num_scansets | 32-bit integer | Number of scansets in granule (1 ... 45) |
| num_scanlines | 32-bit integer | Number of scanlines in granule (3 * num_scansets) |
| start_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees North (-90.0 ... 90.0) |
| start_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees East (-180.0 ... 180.0) |
| start_Time | 64-bit floating-point | TAI Time at start of granule (floating-point elapsed seconds since start of 1993) |
| end_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees North (-90.0 ... 90.0) |

| | | |
|---|---|---|
| end_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees East (-180.0 ... 180.0) |
| end_Time | 64-bit floating-point | TAI Time at end of granule (floating-point elapsed seconds since start of 1993) |
| eq_x_longitude | 32-bit floating-point | Longitude of spacecraft at southward equator crossing nearest granule start in degrees East (-180.0 ... 180.0) |
| eq_x_tai | 64-bit floating-point | Time of eq_x_longitude in TAI units (floating-point elapsed seconds since start of 1993) |
| orbitgeoqa | 32-bit unsigned integer | See Appendix D |
| num_satgeoqa | 16-bit integer | Number of scans with problems in satgeoqa |
| num_glintgeoqa | 16-bit integer | Number of scans with problems in glintgeoqa |
| num_moongeoqa | 16-bit integer | Number of scans with problems in moongeoqa |
| num_ftptgeoqa | 16-bit integer | Number of footprints with problems in ftptgeoqa |
| num_zengeoqa | 16-bit integer | Number of footprints with problems in zengeoqa |
| num_demgeoqa | 16-bit integer | Number of footprints with problems in demgeoqa |
| num_fpe | 16-bit integer | Number of floating point errors |
| LonGranuleCen | 16-bit integer | Geodetic Longitude of the center of the granule in degrees East (-180 ... 180) |
| LatGranuleCen | 16-bit integer | Geodetic Latitude of the center of the granule in degrees North (-90 ... 90) |
| LocTimeGranuleCen | 16-bit integer | Local solar time at the center of the granule in minutes past midnight (0 ... 1439) |
| num_scanlines_not_norm_mode | 32-bit integer | Number of scanlines not in Process state |
| num_missing_scanlines | 32-bit integer | Number of scanlines with state = missing |
| num_data_gaps | 32-bit integer | Number of blocks of scanlines where State is not Process |
| num_instr_mode_changes | 32-bit integer | Number of operational instrument mode changes |
| num_scanlines_rec_cal_prob | 32-bit integer | Number of scanlines with non-zero qa_receiver |
| num_scanlines_sig_coast_xing | 32-bit integer | Number of scanlines with qa_scanline coast crossing bit set |
| num_scanlines_sig_sun_glint | 32-bit integer | Number of scanlines with qa_scanline sun glint bit set |
| MoonInViewMWCount | 32-bit integer | Number of scanlines in granule with the moon in the HSB space view |
| QA_bb_PRT | Limited Engineering Struct (see below) | Blackbody PRT temperature summary QA (C) |
| QA_rec_PRT | Limited Engineering Struct (see below) | Receiver PRT temperature summary QA (C) |
| granules_present | string of 8-bit characters | Zero-terminated character string denoting which adjacent granules were available for smoothing ("All" for both previous & next, "Prev" for previous but not next, "Next" for next but not previous, "None" for neither previous nor next) |
| QA_cal_temp_1 | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_cal_temp_2 | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_cal_temp_3 | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_cal_temp_4 | Limited Engineering Struct (see below) | Warm target temperature QA (C) |

| | | |
|---|---|---|
| QA_cal_temp_5 | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_cal_temp_6 | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_cal_temp_7 | Limited Engineering Struct (see below) | Warm target temperature QA (C) |
| QA_subrefl_temp | Limited Engineering Struct (see below) | Subreflector temperature QA (C) |
| QA_mixer_181920_temp | Limited Engineering Struct (see below) | 183 GHz mixer temp, C |
| QA_mixer_17_temp | Limited Engineering Struct (see below) | 150 GHz mixer temp, C |
| QA_ref_PRT_select | 32-bit unsigned integer | Number of times backup reference PRT selected |
| QA_NFAIL_primPRT | Reference PRT counts (see below) | Failure counts for primary reference PRT |
| QA_NFAIL_secPRT | Reference PRT counts (see below) | Failure counts for secondary reference PRT |

## Per-Granule Data Fields

These fields appear only once per granule and use the HDF-EOS "Field" interface.

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| center_freq | 32-bit floating-point | Channel (= 5) | Channel Center frequency (GHz) |
| IF_offset_1 | 32-bit floating-point | Channel (= 5) | Offset of first intermediate frequency stage (MHz) (zero for no mixing) |
| IF_offset_2 | 32-bit floating-point | Channel (= 5) | Offset of second intermediate frequency stage (MHz) (zero for no second mixing) |
| bandwidth | 32-bit floating-point | Channel (= 5) | Bandwidth of sum of 1, 2, or 4 channels (MHz) |
| num_calibrated_scanlines | 32-bit integer | Channel (= 5) | Number of scanlines that had calibration coefs applied |
| num_scanlines_ch_cal_problems | 32-bit integer | Channel (= 5) | Number of scanlines with non-zero qa_channel |
| bb_signals | Unlimited Engineering Struct (see below) | BBXTrack (= 4) * Channel (= 5) | Statistics on blackbody calibration signals (data numbers with offset subtracted) |
| space_signals | Unlimited Engineering Struct (see below) | SpaceXTrack (= 4) * Channel (= 5) | Statistics on spaceview calibration signals (data numbers with offset subtracted) |
| gain_stats | Unlimited Engineering Struct (see below) | Channel (= 5) | Statistics on gains (count/K) |
| NeDT | 32-bit floating-point | Channel (= 5) | Instrument noise level estimated from warm count scatter (K) |
| QA_unfiltered_scene_count | Unlimited Engineering Struct (see below) | GeoXTrack (= 90) * Channel (= 5) | Per footprint position raw scene count summary QA |
| QA_unfiltered_BB_count | Unlimited Engineering Struct | BBXTrack (= 4) * Channel (= 5) | Per BB footprint position raw warm count summary QA (unfiltered) |

| | | | |
|---|---|---|---|
| | (see below) | | |
| QA_unfiltered_space_count | Unlimited Engineering Struct (see below) | SpaceXTrack (= 4) * Channel (= 5) | Per space footprint position raw cold count summary QA (unfiltered) |
| QA_cal_coef_a0 | Unlimited Engineering Struct (see below) | Channel (= 5) | Calibration coefficient a0 summary QA (K) |
| QA_cal_coef_a1 | Unlimited Engineering Struct (see below) | Channel (= 5) | Calibration coefficient a1 summary QA (K/count) |
| QA_cal_coef_a2 | Unlimited Engineering Struct (see below) | Channel (= 5) | Calibration coefficient a2 summary QA (K/count**2) |
| QA_bb_raw_noise_counts | Unlimited Engineering Struct (see below) | Channel (= 5) | Summary QA on differences between warm cal counts, DT=ABS(T1-T2)/SQRT(2) |
| QA_sv_raw_noise_counts | Unlimited Engineering Struct (see below) | Channel (= 5) | Summary QA on differences between cold cal counts, DT=ABS(T1-T2)/SQRT(2) |
| QA_raw_cold_count | Limited Engineering Struct (see below) | Channel (= 5) | Raw cold count summary QA |
| QA_raw_warm_count | Limited Engineering Struct (see below) | Channel (= 5) | Raw warm count summary QA |
| QA_cold_count | Unlimited Engineering Struct (see below) | Channel (= 5) | (qual and averaged) Cold count summary QA |
| QA_warm_count | Unlimited Engineering Struct (see below) | Channel (= 5) | (qual and averaged) Warm count summary QA |
| QA_smoothed_cold_count | Unlimited Engineering Struct (see below) | Channel (= 5) | Smoothed cold count summary QA |
| QA_smoothed_warm_count | Unlimited Engineering Struct (see below) | Channel (= 5) | Smoothed warm count summary QA |
| QA_raw_count | Unlimited Engineering Struct (see below) | Channel (= 5) | Science count summary QA |
| QA_NFAIL_wPRT | Warm PRT counts (see below) | WarmPRT (= 7) | Failure counts for warm target PRT |
| QA_NFAIL_WC_bad_val | 16-bit integer | Channel (= 5) | Number of warm target input count failures per channel for bad values |
| QA_NFAIL_WC_lo_lim | 16-bit integer | Channel (= 5) | Number of warm target input count failures per channel for Low limit violation |
| QA_NFAIL_WC_hi_lim | 16-bit integer | Channel (= 5) | Number of warm target input count failures per channel for High limit violation |
| QA_NFAIL_CC_bad_val | 16-bit integer | Channel (= 5) | Number of cold cal (space view) input count failures per channel for bad values |
| QA_NFAIL_CC_lo_lim | 16-bit integer | Channel (= 5) | Number of cold cal (space view) input count failures per channel for Low limit violation |
| QA_NFAIL_CC_hi_lim | 16-bit integer | Channel (= 5) | Number of cold cal (space view) input count failures per channel for High limit violation |
| QA_NFAIL_CC_moon_flag | 16-bit integer | Channel (= 5) | Number of cold cal (space view) input count failures per channel for moon in field-of-view |
| QA_NFAIL_CAL_not_proc_state | 16-bit integer | Channel (= 5) | Number of calibration failures per channel for data not in process state (missing or special calibration mode or bad) |
| QA_NFAIL_CAL_no_reuse_coef | 16-bit integer | Channel (= 5) | Number of calibration failures per channel for lack of reusable a0, a1, & a2 coefficients |
| QA_NFAIL_CAL_ref_PRT | 16-bit integer | Channel (= 5) | Number of calibration failures per channel for problems with the reference PRTs |

| | | | |
|---|---|---|---|
| QA_NFAIL_CAL_warm_temp | 16-bit integer | Channel (= 5) | Number of calibration failures per channel for determination of warm target temperature |
| QA_NFAIL_CAL_cold_temp | 16-bit integer | Channel (= 5) | Number of calibration failures per channel for determination of cold cal (space view) temperature |
| QA_NFAIL_CAL_wC_no_val_data | 16-bit integer | Channel (= 5) | Number of calibration failures per channel for insufficient valid warm calibration data |
| QA_NFAIL_CAL_wC_in_scan | 16-bit integer | Channel (= 5) | Number of calibration failures per channel for excessive in-scan warm count variability |
| QA_NFAIL_CAL_wC_smoothing | 16-bit integer | Channel (= 5) | Number of calibration failures per channel for insufficient raw warm counts for smoothing |
| QA_NFAIL_CAL_cC_no_val_data | 16-bit integer | Channel (= 5) | Number of calibration failures per channel for insufficient valid cold cal (space view) data |
| QA_NFAIL_CAL_cC_in_scan | 16-bit integer | Channel (= 5) | Number of calibration failures per channel for excessive in-scan cold count variability |
| QA_NFAIL_CAL_cC_smoothing | 16-bit integer | Channel (= 5) | Number of calibration failures per channel for insufficient raw cold counts for smoothing |
| QA_NFAIL_CAL_chan_missing | 16-bit integer | Channel (= 5) | Number of calibration failures per channel because channel is not implemented (HSB channel #1) |
| QA_NFAIL_CAL_other | 16-bit integer | Channel (= 5) | Number of calibration failures per channel for other reasons |

## Along-Track Data Fields

These fields appear once per scanline (GeoTrack times).

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| satheight | 32-bit floating-point | None | Satellite altitude at nadirTAI in km above reference ellipsoid (e.g. 725.2) |
| satroll | 32-bit floating-point | None | Satellite attitude roll angle at nadirTAI (-180.0 ... 180.0 angle about the +x (roll) ORB axis, +x axis is positively oriented in the direction of orbital flight completing an orthogonal triad with y and z.) |
| satpitch | 32-bit floating-point | None | Satellite attitude pitch angle at nadirTAI (-180.0 ... 180.0 angle about +y (pitch) ORB axis. +y axis is oriented normal to the orbit plane with the positive sense opposite to that of the orbit's angular momentum vector H.) |
| satyaw | 32-bit floating-point | None | Satellite attitude yaw angle at nadirTAI (-180.0 ... 180.0 angle about +z (yaw) axis. +z axis is positively oriented Earthward parallel to the satellite radius vector R from the spacecraft center of mass to the center of the Earth.) |
| satgeoqa | 32-bit unsigned integer | None | See Appendix D |
| glintgeoqa | 16-bit unsigned integer | None | See Appendix D |
| moongeoqa | 16-bit unsigned integer | None | See Appendix D |
| nadirTAI | 64-bit floating-point | None | TAI time at which instrument is nominally looking directly down. (between footprints 15 & 16 for AMSU or between footprints 45 & 46 for AIRS/Vis & HSB) (floating-point elapsed seconds since start of 1993) |
| sat_lat | 64-bit floating-point | None | Satellite geodetic latitude in degrees North (-90.0 ... 90.0) |
| sat_lon | 64-bit floating-point | None | Satellite geodetic longitude in degrees East (-180.0 ... 180.0) |
| scan_node_type | 8-bit integer | None | 'A' for ascending, 'D' for descending, 'E' when an error is encountered in trying to determine a value. |

| | | | |
|---|---|---|---|
| glintlat | 32-bit floating-point | None | Solar glint geodetic latitude in degrees North at nadirTAI (-90.0 ... 90.0) |
| glintlon | 32-bit floating-point | None | Solar glint geodetic longitude in degrees East at nadirTAI (-180.0 ... 180.0) |
| state | 32-bit integer | None | Data state: 0:Process, 1:Special, 2:Erroneous, 3:Missing |
| qa_primPRT | 8-bit unsigned integer | None | Receiver bitmap for HSB primary PRT: Bit 0: (LSB, value 1) Failed bad value;<br>Bit 1: (value 2) Failed low limit test;<br>Bit 2: (value 4) Failed high limit test;<br>Bit 3: (value 8) Failed cross-scan test |
| qa_secPRT | 8-bit unsigned integer | None | Receiver bitmap for HSB secondary PRT (bits defined as for qa_primPRT) |
| qa_wPRT_bad_val | 8-bit unsigned integer | None | Warm target bad values bitmap for HSB PRTs: Bits 0 (LSB)-6: problem with PRTs 1-7 |
| qa_wPRT_lo_lim | 8-bit unsigned integer | None | Warm target Low limit bitmap for HSB PRTs (bits defined as for qa_wPRT_bad_val) |
| qa_wPRT_hi_lim | 8-bit unsigned integer | None | Warm target High limit bitmap for HSB PRTs (bits defined as for qa_wPRT_bad_val) |
| qa_wPRT_in_scan | 8-bit unsigned integer | None | Warm target in-scan bitmap for HSB PRTs (bits defined as for qa_wPRT_bad_val) |
| qa_wPRT_x_scan | 8-bit unsigned integer | None | Warm target cross-scan bitmap for HSB PRTs (bits defined as for qa_wPRT_bad_val) |
| qa_WC_bad_val | 16-bit unsigned integer | BBXTrack (= 4) | Warm target input counts bad values: Bits 0 (LSB)-4: problem with channels 1-5 |
| qa_WC_lo_lim | 16-bit unsigned integer | BBXTrack (= 4) | Warm target input counts Low limit: Bits 0 (LSB)-4: problem with channels 1-5 |
| qa_WC_hi_lim | 16-bit unsigned integer | BBXTrack (= 4) | Warm target input counts High limit: Bits 0 (LSB)-4: problem with channels 1-5 |
| qa_CC_bad_val | 16-bit unsigned integer | SpaceXTrack (= 4) | Cold cal input counts bad values: Bits 0 (LSB)-4: problem with channels 1-5 |
| qa_CC_lo_lim | 16-bit unsigned integer | SpaceXTrack (= 4) | Cold cal input counts Low limit: Bits 0 (LSB)-4: problem with channels 1-5 |
| qa_CC_hi_lim | 16-bit unsigned integer | SpaceXTrack (= 4) | Cold cal input counts High limit: Bits 0 (LSB)-4: problem with channels 1-5 |
| qa_CC_moon_flag | 16-bit unsigned integer | SpaceXTrack (= 4) | Cold cal input counts moon flag: Bits 0 (LSB)-4: problem with channels 1-5 |
| qa_calibration | 16-bit unsigned integer | Channel (= 5) | Calibration QA bitmap: Bit 0: (LSB, value 1) not in process state;<br>Bit 1: (value 2) no coef for reuse;<br>Bit 2: (value 4) Reference PRT;<br>Bit 3: (value 8) Warm Temp Cal;<br>Bit 4: (value 16) Cold Temp Cal;<br>Bit 5: (value 32) Warm Counts - no good counts;<br>Bit 6: (value 64) Warm Counts - in-scan dev;<br>Bit 7: (value 128) Warm Counts - smooth threshold;<br>Bit 8: (value 256) Cold Counts - no good counts;<br>Bit 9: (value 512) Cold Counts - in-scan dev;<br>Bit 10: (value 1024) Cold Counts - smooth threshold;<br>Bit 11: (value 2048) Failed - channel not implemented;<br>Bit 12: (value 4096) Other failure |

| | | | |
|---|---|---|---|
| cal_coef_a0 | 32-bit floating-point | Channel (= 5) | Calibration coefficients to convert raw counts to antenna temperature (K) |
| cal_coef_a0_err | 32-bit floating-point | Channel (= 5) | Error estimate for cal_coef_a0 (K) |
| cal_coef_a1 | 32-bit floating-point | Channel (= 5) | Calibration coefficients to convert raw counts to antenna temperature (K/count) |
| cal_coef_a1_err | 32-bit floating-point | Channel (= 5) | Error estimate for cal_coef_a1 (K/count) |
| cal_coef_a2 | 32-bit floating-point | Channel (= 5) | Calibration coefficients to convert raw counts to antenna temperature (K/count**2) |
| cal_coef_a2_err | 32-bit floating-point | Channel (= 5) | Error estimate for cal_coef_a2 (K/count**2) |
| bb_brightness | 32-bit floating-point | Channel (= 5) | Blackbody brightness temperature (Tbw) (K) |
| bb_brightness_err | 32-bit floating-point | Channel (= 5) | Blackbody brightness temperature error (delta-Tbw) (K) |
| spaceview_temp | 32-bit floating-point | Channel (= 5) | Spaceview brightness temperature (Tbc) (K) |
| spaceview_temp_err | 32-bit floating-point | Channel (= 5) | Spaceview brightness temperature error (delta-Tbc) (K) |
| cold_count | 32-bit floating-point | Channel (= 5) | Qual and averaged cold cal (space view) counts for this scanline (counts) |
| warm_count | 32-bit floating-point | Channel (= 5) | Qual and averaged warm cal (target view) counts for this scanline (counts) |
| smoothed_cold_count | 32-bit floating-point | Channel (= 5) | Smoothed cold cal counts for this scanline (counts) |
| smoothed_warm_count | 32-bit floating-point | Channel (= 5) | Smoothed warm cal counts for this scanline (counts) |
| SpacViewSelct | 8-bit integer | None | Space View Selected |
| mixer_17_temp_used | 8-bit integer | None | Mixer 17 Temperature use flag. (1: used mixer 17 temperature for receiver temperature;<br>0: used mixer 18/19/20 temperature) |
| receiver_temp | 32-bit floating-point | None | Receiver temperature used in calibration (mixer 17 temperature or mixer 18/19/20 temperature as specified by mixer_17_temp_used) (C) |
| target_temp | 32-bit floating-point | None | HSB target temperature used in calibration (C) |
| qa_scanline | 8-bit unsigned integer | None | Scanline bitmap for HSB: Bit 0: (LSB, value 1) Sun glint in this scanline;<br>Bit 1: (value 2) Coastal crossing in this scanline;<br>Bit 2: (value 4) Some channels had excessive NeDT estimate;<br>Bit 3: (value 8) Near sidelobe correction applied |
| qa_receiver | 8-bit unsigned integer | None | Receiver bitmap for HSB: Bit 0: (LSB, value 1) Calibration was not derived, due to the instrument mode;<br>Bit 1: (value 2) Calibration was not derived, due to bad or missing PRT values;<br>Bit 2: (value 4) This scanline was calibrated, but the moon was in the space view;<br>Bit 3: (value 8) This scanline was calibrated, but there was a space view scan position err; |

| | | | |
|---|---|---|---|
| | | | Bit 4: (value 16) This scanline was calibrated, but there was a blackbody scan position error;<br>Bit 5: (value 32) This scanline was calibrated, but some PRT values were bad or marginal;<br>Bit 6: (value 64) This scanline was calibrated, but there was a data gap;<br>Bit 7: (value 128) Some channels were not calibrated |
| qa_channel | 8-bit unsigned integer | Channel (= 5) | Channel bitmap for HSB: Bit 0: (LSB, value 1) All space view counts were bad for this channel and scanline;<br>Bit 1: (value 2) Space view counts were marginal for this channel and scanline;<br>Bit 2: (value 4) Space view counts could not be smoothed;<br>Bit 3: (value 8) All blackbody counts were bad for this channel and scanline;<br>Bit 4: (value 16) Blackbody counts were marginal for this channel and scanline;<br>Bit 5: (value 32) Blackbody counts could not be smoothed;<br>Bit 6: (value 64) Most recent calibration coefficients used;<br>Bit 7: (value 128) Excessive NeDT estimated |

## Full Swath Data Fields

These fields appear for every footprint of every scanline in the granule (GeoTrack * GeoXTrack times).

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| scanang | 32-bit floating-point | None | Scanning angle of HSB instrument with respect to the HSB instrument for this footprint (-180.0 ... 180.0, negative at start of scan, 0 at nadir) |
| ftptgeoqa | 32-bit unsigned integer | None | See Appendix D |
| zengeoqa | 16-bit unsigned integer | None | See Appendix D |
| demgeoqa | 16-bit unsigned integer | None | See Appendix D |
| satzen | 32-bit floating-point | None | Spacecraft zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| satazi | 32-bit floating-point | None | Spacecraft azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| solzen | 32-bit floating-point | None | Solar zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| solazi | 32-bit floating-point | None | Solar azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| sun_glint_distance | 16-bit integer | None | Distance (km) from footprint center to location of the sun glint (-9999 for unknown, 30000 for no glint visible because spacecraft is in Earth's shadow) |
| topog | 32-bit floating-point | None | Mean topography in meters above reference ellipsoid |
| topog_err | 32-bit floating-point | None | Error estimate for topog |
| landFrac | 32-bit floating-point | None | Fraction of spot that is land (0.0 ... 1.0) |
| landFrac_err | 32-bit floating-point | None | Error estimate for landFrac |
| antenna_temp | 32-bit floating-point | Channel (= 5) | Raw antenna temperature in Kelvins |
| brightness_temp | 32-bit floating-point | Channel (= 5) | Brightness temperature. Same as antenna_temp because sidelobe correction is small and ground truth is less known for water vapor. (K) |
| brightness_temp_err | 32-bit floating-point | Channel (= 5) | Uncertainty in empirically derived brightness_temp bias correction, excluding radiometer noise. (K) |
| bt_sidelobe_corr | 32-bit floating-point | Channel (= 5) | Correction to raw antenna temperature to give brightness_temp. This correction accounts for near- and far- sidelobe effects. (K) |

## Special AIRS Types

AIRS works around the lack of support for records in HDF-EOS Swath by grouping related fields into pseudo-records. HDF-EOS fieldnames are generated by concatenating the pseudo-record name with the subfield name, putting a "." character in between. Since these record types do not exist at the HDF-EOS swath level, reading subfield "min" of AIRS field "QA_bb_PRT" involves reading HDF-EOS Swath field "QA_bb_PRT.min".

Limited Engineering Struct: This type is used for engineering data fields for which there are known "yellow" limits.

| Field Name | Type | Explanation |
|---|---|---|
| min | 32-bit floating-point | Minimum value field takes on in granule (not valid when num_in = 0) |
| max | 32-bit floating-point | Maximum value field takes on in granule (not valid when num_in = 0) |
| mean | 32-bit floating-point | Mean of values field takes on in granule (not valid when num_in = 0) |
| dev | 32-bit floating-point | Standard Deviation of values field takes on in granule (not valid when num_in < 2) |
| num_in | 32-bit integer | Count of in-range values field takes on in granule |
| num_lo | 32-bit integer | Count of out-of-range low values field takes on in granule |
| num_hi | 32-bit integer | Count of out-of-range high values field takes on in granule |
| num_bad | 32-bit integer | Count of occassions on which field takes on invalid flag value (-9999) in granule |
| range_min | 32-bit floating-point | Minimum in-range value. |
| range_max | 32-bit floating-point | Maximum in-range value. |
| missing | 8-bit integer | Missing limits flags. Bit 0 (LSB) is 1 when yellow low (range_min) limit is missing;<br>Bit 1 is high when yellow high (range_max) limit is missing;<br>other bits unused, set to 0. |
| max_track | 32-bit integer | GeoTrack index (counting from 1) where max was found |
| max_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where max was found |
| min_track | 32-bit integer | GeoTrack index (counting from 1) where min was found |
| min_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where min was found |

Unlimited Engineering Struct: This type is used for engineering data fields for which there are NOT known "yellow" limits.

| Field Name | Type | Explanation |
|---|---|---|
| min | 32-bit floating-point | Minimum value field takes on in granule (not valid when num = 0) |
| max | 32-bit floating-point | Maximum value field takes on in granule (not valid when num = 0) |
| mean | 32-bit floating-point | Mean of values field takes on in granule (not valid when num = 0) |
| dev | 32-bit floating-point | Standard Deviation of values field takes on in granule (not valid when num < 2) |
| num | 32-bit integer | Count of occurrences of field in granule (not including those counted in num_bad) |
| num_bad | 32-bit integer | Count of occassions on which field takes on invalid flag value (-9999) in granule |
| max_track | 32-bit integer | GeoTrack index (counting from 1) where max was found |
| max_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where max was found |
| min_track | 32-bit integer | GeoTrack index (counting from 1) where min was found |
| min_xtrack | 32-bit integer | GeoXTrack index (counting from 1) where min was found |

Reference PRT counts: This type provides counts of rejection due to each rejection criterion for reference PRTs for MW instruments.

| Field Name | Type | Explanation |
|---|---|---|
| bad_value | 16-bit integer | Bad value |
| lo_lim | 16-bit integer | Low limit |
| hi_lim | 16-bit integer | High limit |
| x_scan | 16-bit integer | Large cross-scan deviation |

Warm PRT counts: This type provides counts of rejection due to each rejection criterion for warm target PRTs for MW instruments.

| Field Name | Type | Explanation |
|---|---|---|
| bad_value | 16-bit integer | Bad value |
| lo_lim | 16-bit integer | Low limit |
| hi_lim | 16-bit integer | High limit |
| in_scan | 16-bit integer | Large within-scan deviation |
| x_scan | 16-bit integer | Large cross-scan deviation |

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# A1-9. L2 Standard Atmospheric/Surface Product Interface Specification

Interface Specification Version 6.0.7.0
2012-08-28

ESDT ShortNames = "AIRX2RET", “AIRS2RET”, “AIRH2RET”’

DOIs = “10.5067/AQUA/AIRS/DATA201”, “10.5067/AQUA/AIRS/DATA202”, “10.5067/AQUA/AIRS/DATA203”

Swath Name = "L2_Standard_atmospheric&surface_product"

Level = "Level2"

# Footprints = 30

# scanlines per scanset = 1

## Dimensions

**These fields define all dimensions that can be used for HDF-EOS swath fields.**

**The names "GeoTrack" and "GeoXTrack" have a special meaning for this document: "Cross-Track" data fields have a hidden dimension of "GeoXTrack"; "Along-Track" data fields have a hidden dimension of "GeoTrack"; "Full Swath Data Fields have hidden dimensions of both "GeoTrack" and "GeoXTrack".**

| Name | Value | Explanation |
|---|---|---|
| GeoXTrack | 30 | Dimension across track for footprint positions. Same as number of footprints per scanline. -- starting at the left and increasing towards the right as you look along the satellite's path |
| GeoTrack | # of scan lines in swath | Dimension along track for footprint positions. Same as number of scanlines in granule. Parallel to the satellite's path, increasing with time. (Nominally 45) |
| StdPressureLev | 28 | Number of standard pressure altitude levels (from bottom of the atmosphere up). |
| StdPressureLay | 28 | Number of standard pressure altitude layers (Always equal to StdPressureLev: last layer goes to the top of the atmosphere). |
| AIRSXTrack | 3 | The number of AIRS cross-track spots per AMSU-A spot. Direction is the same as GeoXTrack -- starting at the left and increasing towards the right as you look along the satellite's path |
| AIRSTrack | 3 | The number of AIRS along-track spots per AMSU-A spot. Direction is the same as GeoTrack -- parallel to the satellite's path, increasing with time |

| | | |
|---|---|---|
| Cloud | 2 | Cloud layer dimension in order of increasing pressure. Only first nCld or numCloud elements are valid |
| MWHingeSurf | 7 | Number of standard frequency hinge points in Microwave surface emissivity and surface brightness. Frequencies are 23.8, 31.4, 50.3, 52.8, 89.0, 150.0, 183.31 GHz respectively.Values are also found in field MWHingeSurfFreqGHz. |
| H2OFunc | 11 | Functions on which water vapor retrieval is calculated |
| O3Func | 9 | Functions on which ozone retrieval is calculated |
| COFunc | 9 | Functions on which carbon monoxide retrieval is calculated |
| CH4Func | 10 | Functions on which methane retrieval is calculated |
| HingeSurf | 100 | Maximum number of frequency hinge points in IR surface emissivity |
| H2OPressureLev | 15 | Number of water vapor pressure altitude levels (from bottom of the atmosphere up). |
| H2OPressureLay | 14 | Number of standard pressure altitude layers (Always one less than H2OPressureLev). |

## Geolocation Fields

### These fields appear for every footprint (GeoTrack * GeoXTrack times) and correspond to footprint center coordinates and "shutter" time.

| Name | Explanation |
|---|---|
| Latitude | Footprint boresight geodetic Latitude in degrees North (-90.0 ... 90.0) |
| Longitude | Footprint boresight geodetic Longitude in degrees East (-180.0 ... 180.0) |
| Time | Footprint "shutter" TAI Time: floating-point elapsed seconds since Jan 1, 1993 |

## Attributes

### These fields appear only once per granule and use the HDF-EOS "Attribute" interface

| Name | Type | Explanation |
|---|---|---|
| processing_level | string of 8-bit characters | Zero-terminated character string denoting processing level ("Level2") |
| instrument | string of 8-bit characters | Zero-terminated character string denoting instrument ("AIRS") |
| DayNightFlag | string of 8-bit characters | Zero-terminated character string set to "Night" when the subsatellite points at the beginning and end of a granule are both experiencing night according to the "civil twilight" standard (center of refracted sun is below the horizon). It is set to "Day" when both are experiencing day, and "Both" when one is experiencing day and the other night. "NA" is used when a determination cannot be made. |
| AutomaticQAFlag | string of 8-bit characters | Zero-terminated character string denoting granule data quality: (Always "Passed", "Failed", or "Suspect") |
| NumTotalData | 32-bit integer | Total number of expected scene footprints |

| | | |
|---|---|---|
| NumProcessData | 32-bit integer | Number of scene footprints which are present and can be processed routinely (state = 0) |
| NumSpecialData | 32-bit integer | Number of scene footprints which are present and can be processed only as a special test (state = 1) |
| NumBadData | 32-bit integer | Number of scene footprints which are present but cannot be processed (state = 2) |
| NumMissingData | 32-bit integer | Number of expected scene footprints which are not present (state = 3) |
| NumLandSurface | 32-bit integer | Number of scene footprints for which the surface is more than 90% land |
| NumOceanSurface | 32-bit integer | Number of scene footprints for which the surface is less than 10% land |
| node_type | string of 8-bit characters | Zero-terminated character string denoting whether granule is ascending, descending, or pole-crossing: ("Ascending" and "Descending" for entirely ascending or entirely descending granules, or "NorthPole" or "SouthPole" for pole-crossing granules. "NA" when determination cannot be made.) |
| start_year | 32-bit integer | Year in which granule started, UTC (e.g. 1999) |
| start_month | 32-bit integer | Month in which granule started, UTC (1 ... 12) |
| start_day | 32-bit integer | Day of month in which granule started, UTC (1 ... 31) |
| start_hour | 32-bit integer | Hour of day in which granule started, UTC (0 ... 23) |
| start_minute | 32-bit integer | Minute of hour in which granule started, UTC (0 ... 59) |
| start_sec | 32-bit floating-point | Second of minute in which granule started, UTC (0.0 ... 59.0) |
| start_orbit | 32-bit integer | Orbit number of mission in which granule started |
| end_orbit | 32-bit integer | Orbit number of mission in which granule ended |
| orbit_path | 32-bit integer | Orbit path of start orbit (1 ... 233 as defined by EOS project) |
| start_orbit_row | 32-bit integer | Orbit row at start of granule (1 ... 248 as defined by EOS project) |
| end_orbit_row | 32-bit integer | Orbit row at end of granule (1 ... 248 as defined by EOS project) |
| granule_number | 32-bit integer | Number of granule within day (1 ... 240) |
| num_scansets | 32-bit integer | Number of scansets in granule (1 ... 45) |
| num_scanlines | 32-bit integer | Number of scanlines in granule (1 * num_scansets) |
| start_Latitude | 64-bit | Geodetic Latitude of spacecraft at start of granule (subsatellite |

| | | |
|---|---|---|
| | floating-point | location at midpoint of first scan) in degrees North (-90.0 ... 90.0) |
| start_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees East (-180.0 ... 180.0) |
| start_Time | 64-bit floating-point | TAI Time at start of granule (floating-point elapsed seconds since start of 1993) |
| end_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees North (-90.0 ... 90.0) |
| end_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees East (-180.0 ... 180.0) |
| end_Time | 64-bit floating-point | TAI Time at end of granule (floating-point elapsed seconds since start of 1993) |
| eq_x_longitude | 32-bit floating-point | Longitude of spacecraft at southward equator crossing nearest granule start in degrees East (-180.0 ... 180.0) |
| eq_x_tai | 64-bit floating-point | Time of eq_x_longitude in TAI units (floating-point elapsed seconds since start of 1993) |
| LonGranuleCen | 16-bit integer | Geodetic Longitude of the center of the granule in degrees East (-180 ... 180) |
| LatGranuleCen | 16-bit integer | Geodetic Latitude of the center of the granule in degrees North (-90 ... 90) |
| LocTimeGranuleCen | 16-bit integer | Local solar time at the center of the granule in minutes past midnight (0 ... 1439) |
| num_fpe | 16-bit integer | Number of floating point errors |
| orbitgeoqa | 32-bit unsigned integer | See Appendix D |
| num_satgeoqa | 16-bit integer | Number of scans with problems in satgeoqa |
| num_glintgeoqa | 16-bit integer | Number of scans with problems in glintgeoqa |
| num_moongeoqa | 16-bit integer | Number of scans with problems in moongeoqa |
| num_ftptgeoqa | 16-bit integer | Number of footprints with problems in ftptgeoqa |
| num_zengeoqa | 16-bit integer | Number of footprints with problems in zengeoqa |
| num_demgeoqa | 16-bit integer | Number of footprints with problems in demgeoqa |
| CO_first_guess | string of 8-bit | Name of CO First Guess source. |

| | | |
|---|---|---|
| | characters | |
| CH4_first_guess | string of 8-bit characters | Name of CH4 First Guess source. |
| NumSO2FOVs | 16-bit unsigned integer | Number of fields-of-view (out of a nominal 1350) with a signifcant SO2 concentration based on the value of BT_diff_SO2. |

## Per-Granule Data Fields

### These fields appear only once per granule and use the HDF-EOS "Field" interface

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| pressStd | 32-bit floating-point | StdPressureLev (= 28) | Standard pressures in hPa (bottom of the atmosphere first) |
| pressH2O | 32-bit floating-point | H2OPressureLev (= 15) | Water vapor pressures in hPa (bottom of the atmosphere first) |
| MWHingeSurfFreqGHz | 32-bit floating-point | MWHingeSurf (= 7) | Frequencies in GHz for MW surface parameters (SfcTbMWStd, EmisMWStd,...) |

## Along-Track Data Fields

### These fields appear once per scanline (GeoTrack times)

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| satheight | 32-bit floating-point | None | Satellite altitude at nadirTAI in km above reference ellipsoid (e.g. 725.2) |
| satroll | 32-bit floating-point | None | Satellite attitude roll angle at nadirTAI (-180.0 ... 180.0 angle about the +x (roll) ORB axis, +x axis is positively oriented in the direction of orbital flight completing an orthogonal triad with y and z.) |
| satpitch | 32-bit floating-point | None | Satellite attitude pitch angle at nadirTAI (-180.0 ... 180.0 angle about +y (pitch) ORB axis. +y axis is oriented normal to the orbit plane with the positive sense opposite to that of the orbit's angular momentum vector H.) |
| satyaw | 32-bit floating-point | None | Satellite attitude yaw angle at nadirTAI (-180.0 ... 180.0 angle about +z (yaw) axis. +z axis is positively oriented Earthward parallel to the satellite radius vector R from the spacecraft center of mass to the center of the Earth.) |
| glintlat | 32-bit floating-point | None | Solar glint geodetic latitude in degrees North at nadirTAI (-90.0 ... 90.0) |

| | | | |
|---|---|---|---|
| glintlon | 32-bit floating-point | None | Solar glint geodetic longitude in degrees East at nadirTAI (-180.0 ... 180.0) |
| nadirTAI | 64-bit floating-point | None | TAI time at which instrument is nominally looking directly down. (between footprints 15 & 16 for AMSU or between footprints 45 & 46 for AIRS/Vis & HSB) (floating-point elapsed seconds since start of 1993) |
| sat_lat | 64-bit floating-point | None | Satellite geodetic latitude in degrees North (-90.0 ... 90.0) |
| sat_lon | 64-bit floating-point | None | Satellite geodetic longitude in degrees East (-180.0 ... 180.0) |
| scan_node_type | 8-bit integer | None | 'A' for ascending, 'D' for descending, 'E' when an error is encountered in trying to determine a value. |
| satgeoqa | 32-bit unsigned integer | None | See Appendix D |
| glintgeoqa | 16-bit unsigned integer | None | See Appendix D |
| moongeoqa | 16-bit unsigned integer | None | See Appendix D |

## Full Swath Data Fields

### These fields appear for every footprint of every scanline in the granule (GeoTrack * GeoXTrack times)

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| **Geolocation** | | | |
| satzen | 32-bit floating-point | None | Spacecraft zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| satazi | 32-bit floating-point | None | Spacecraft azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| solzen | 32-bit floating-point | None | Solar zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |

| | | | |
|---|---|---|---|
| solazi | 32-bit floating-point | None | Solar azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| sun_glint_distance | 16-bit integer | None | Distance (km) from footprint center to location of the sun glint (-9999 for unknown, 30000 for no glint visible because spacecraft is in Earth's shadow) |
| **Surface ancillary information from geolocation** | | | |
| topog | 32-bit floating-point | None | Mean topography in meters above reference ellipsoid |
| topog_err | 32-bit floating-point | None | Error estimate for topog |
| landFrac | 32-bit floating-point | None | Fraction of spot that is land (0.0 ... 1.0) |
| landFrac_err | 32-bit floating-point | None | Error estimate for landFrac |
| latAIRS | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Geodetic center latitude of AIRS spots in degrees North (-90.0 ... 90.0) |
| lonAIRS | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Geodetic center longitude of AIRS spots in degrees East (-180.0 ... 180.0) |
| PSurfStd | 32-bit floating-point | None | Surface pressure first guess in hPa, interpolated from forecast |
| PSurfStd_QC | 16-bit unsigned integer | None | Quality flag for surface pressure guess input.;<br>0: Highest Quality -- from timely forecast;<br>1: Good Quality -- from climatology;<br>2: Do Not Use |
| nSurfStd | 32-bit integer | None | Index in pressStd array of first pressure level above mean surface (1 ... 15) |
| **Quality Indicator Pressure Boundaries** | | | |
| PBest | 32-bit floating-point | None | Maximum value of pressure for which temperature is Quality = 0 (hPa) |
| PGood | 32-bit floating-point | None | Maximum value of pressure for which temperature is Quality = 0 or 1 (hPa) |
| nBestStd | 16-bit integer | None | Standard level index of highest pressure (i.e. lowest altitude)for |

| | | | |
|---|---|---|---|
| | | | which Quality = 0. A value of 29 indicates that no part of the profile passes the test. (1 ... 29) |
| nGoodStd | 16-bit integer | None | Standard level index of highest pressure (i.e. lowest altitude)for which Quality = 0 or 1. A value of 29 indicates that no part of the profile passes the test. (1 ... 29) |
| **Surface Property Retrievals** | | | |
| TSurfStd | 32-bit floating-point | None | Surface skin temperature in Kelvins |
| TSurfStd_QC | 16-bit unsigned integer | None | Quality flag for TSurfStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| TSurfStdErr | 32-bit floating-point | None | Error estimate for TSurfStd |
| numHingeSurf | 16-bit integer | None | Number of IR hinge points for surface emissivity and reflectivity |
| freqEmis | 32-bit floating-point | HingeSurf (= 100) | Frequencies for surface emissivity and reflectivity in cm-1 (in order of increasing frequency. Only first numHingeSurf elements are valid) |
| emisIRStd | 32-bit floating-point | HingeSurf (= 100) | Spectral IR Surface Emissivities (in order of increasing frequency. Only first numHingeSurf elements are valid) |
| emisIRStd_QC | 16-bit unsigned integer | HingeSurf (= 100) | Quality Control for emisIRStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| emisIRStdErr | 32-bit floating-point | HingeSurf (= 100) | Error estimate for emisIRStd |
| **Air Temperature Retrievals** | | | |
| TAirStd | 32-bit floating-point | StdPressureLev (= 28) | Atmospheric Temperature at StdPressLev in Kelvins. |
| TAirStd_QC | 16-bit unsigned integer | StdPressureLev (= 28) | Quality Control for TAirStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| TAirStdErr | 32-bit floating-point | StdPressureLev (= 28) | Error estimate for TAirStd |
| TSurfAir | 32-bit floating- | None | Surface air temperature in Kelvins |

| | | | |
|---|---|---|---|
| | point | | |
| TSurfAir_QC | 16-bit unsigned integer | None | Quality Control for TSurfAir.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| TSurfAirErr | 32-bit floating-point | None | Error estimate for TSurfAir |
| Temp_dof | 32-bit floating-point | None | Measure of the amount of information in temperature profile retrieval (deg of freedom). |
| **Water Vapor Saturation Quantities Derived from Temperature** | | | |
| H2OMMRSat | 32-bit floating-point | H2OPressureLay (= 14) | Layer Water vapor saturation mass mixing ratio (gm / kg dry air) over equilibrium phase (set to -9999. when saturation pressure exceeds 1% of ambient pressure.) |
| H2OMMRSat_QC | 16-bit unsigned integer | H2OPressureLay (= 14) | Quality Control for H2OMMRSat.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| H2OMMRSatLevStd | 32-bit floating-point | H2OPressureLev (= 15) | Level Water vapor saturation mass mixing ratio (gm / kg dry air) over equilibrium phase (set to -9999. when saturation pressure exceeds 1% of ambient pressure.) |
| H2OMMRSatLevStd_QC | 16-bit unsigned integer | H2OPressureLev (= 15) | Quality Control for H2OMMRSatLevStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| H2OMMRSatSurf | 32-bit floating-point | None | Water Vapor saturation Mass Mixing Ratio at the surface (gm / kg dry air) over equilibrium phase |
| H2OMMRSatSurf_QC | 16-bit unsigned integer | None | Quality Control for H2OMMRSatSurf.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| H2OMMRSat_liquid | 32-bit floating-point | H2OPressureLay (= 14) | Layer Water vapor saturation mass mixing ratio (gm / kg dry air) over liquid phase (set to -9999. when saturation pressure exceeds 1% of ambient pressure.) |
| H2OMMRSat_liquid_QC | 16-bit unsigned integer | H2OPressureLay (= 14) | Quality Control for H2OMMRSat_liquid.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| H2OMMRSatLevStd_liquid | 32-bit | H2OPressureLev | Level Water vapor saturation mass |

| | | | |
|---|---|---|---|
| | floating-point | (= 15) | mixing ratio (gm / kg dry air) over liquid phase (set to -9999. when saturation pressure exceeds 1% of ambient pressure.) |
| H2OMMRSatLevStd_liquid_QC | 16-bit unsigned integer | H2OPressureLev (= 15) | Quality Control for H2OMMRSatLevStd_liquid.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| H2OMMRSatSurf_liquid | 32-bit floating-point | None | Water Vapor saturation Mass Mixing Ratio at the surface (gm / kg dry air) over liquid phase |
| H2OMMRSatSurf_liquid_QC | 16-bit unsigned integer | None | Quality Control for H2OMMRSatSurf_liquid.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| **Tropopause Derived from Temperature** | | | |
| PTropopause | 32-bit floating-point | None | Tropopause height (hPa) |
| PTropopause_QC | 16-bit unsigned integer | None | Quality Control for PTropopause.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| T_Tropopause | 32-bit floating-point | None | Tropopause temperature (K) |
| T_Tropopause_QC | 16-bit unsigned integer | None | Quality Control for T_Tropopause.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| **Water Vapor Retrievals** | | | |
| totH2OStd | 32-bit floating-point | None | Total precipitable water vapor (kg / m**2) |
| totH2OStd_QC | 16-bit unsigned integer | None | Quality Control for totH2OStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| totH2OStdErr | 32-bit floating-point | None | Error estimate for totH2OStd |
| H2OMMRStd | 32-bit floating-point | H2OPressureLay (= 14) | Water Vapor Mass Mixing Ratio (gm / kg dry air) |
| H2OMMRStd_QC | 16-bit unsigned integer | H2OPressureLay (= 14) | Quality Control for H2OMMRStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |

| | | | |
|---|---|---|---|
| H2OMMRStdErr | 32-bit floating-point | H2OPressureLay (= 14) | Error estimate for H2OMMRStd |
| H2OMMRLevStd | 32-bit floating-point | H2OPressureLev (= 15) | Water Vapor Mass Mixing Ratio (gm / kg dry air) |
| H2OMMRLevStd_QC | 16-bit unsigned integer | H2OPressureLev (= 15) | Quality Control for H2OMMRLevStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| H2OMMRLevStdErr | 32-bit floating-point | H2OPressureLev (= 15) | Error estimate for H2OMMRLevStd |
| H2OMMRSurf | 32-bit floating-point | None | Water Vapor Mass Mixing Ratio at the surface (gm / kg dry air) |
| H2OMMRSurf_QC | 16-bit unsigned integer | None | Quality Control for H2OMMRSurf.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| H2OMMRSurfErr | 32-bit floating-point | None | Error estimate for H2OMMRSurf |
| num_H2O_Func | 16-bit integer | None | Number of valid entries in each dimension of H2O_ave_kern. |
| H2O_verticality | 32-bit floating-point | H2OFunc (= 11) | Sum of the rows of H2O_ave_kern. |
| H2O_dof | 32-bit floating-point | None | Measure of the amount of information in H2O retrieval (deg of freedom). |
| **Relative Humidity Derived from Temperature and Water Vapor** | | | |
| RelHum | 32-bit floating-point | H2OPressureLev (= 15) | Relative humidity over equilibrium phase (%) |
| RelHum_QC | 16-bit unsigned integer | H2OPressureLev (= 15) | Quality control for RelHum.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| RelHumSurf | 32-bit floating-point | None | Relative humidity at the surface over equilibrium phase (%) |
| RelHumSurf_QC | 16-bit unsigned integer | None | Quality Control for RelHumSurf.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| RelHum_liquid | 32-bit floating- | H2OPressureLev (= 15) | Relative humidity over liquid phase (%) |

| | | | |
|---|---|---|---|
| | point | | |
| RelHum_liquid_QC | 16-bit unsigned integer | H2OPressureLev (= 15) | Quality control for RelHum_liquid.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| RelHumSurf_liquid | 32-bit floating-point | None | Relative humidity at the surface over liquid phase (%) |
| RelHumSurf_liquid_QC | 16-bit unsigned integer | None | Quality Control for RelHumSurf_liquid.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| **Geopotential Height Derived from Temperature and Water Vapor** | | | |
| GP_Tropopause | 32-bit floating-point | None | Geopotential height at tropopause (m above mean sea level) |
| GP_Tropopause_QC | 16-bit unsigned integer | None | Quality Control for GP_Tropopause.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| GP_Height | 32-bit floating-point | StdPressureLev (= 28) | Geopotential Heights at StdPressureLev (m above mean sea level) |
| GP_Height_QC | 16-bit unsigned integer | StdPressureLev (= 28) | Quality Control for GP_Height.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| GP_Surface | 32-bit floating-point | None | Geopotential Height of surface (m above mean sea level) |
| GP_Surface_QC | 16-bit unsigned integer | None | Quality Control for GP_Surface.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| **Cloud Formation Retrievals on 3 by 3 AIRS Fields of View** | | | |
| CldFrcTot | 32-bit floating-point | None | Total cloud fraction over all cloud layers and all 9 spots (0.0 ... 1.0) assuming unit cloud top emissivity. |
| CldFrcTot_QC | 16-bit unsigned integer | None | Quality Control for CldFrcTot.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| CldFrcStd | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) * Cloud (= 2) | Cloud fraction (0.0 ... 1.0) assuming unit cloud top emissivity (in order of increasing pressure. Only first nCld elements are valid) Caution: For CldFrcStd = 1, only the average cloud fraction over the |

| | | | |
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| | | | nine spots is reported (duplicated nine times) for each level. |
| CldFrcStd_QC | 16-bit unsigned integer | AIRSTrack (= 3) * AIRSXTrack (= 3) * Cloud (= 2) | Quality Control for CldFrcStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| CldFrcStdErr | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) * Cloud (= 2) | Error estimate for CldFrcStd |
| PCldTop | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) * Cloud (= 2) | Cloud top pressure in hPa. (in order of increasing pressure. Only first nCld elements are valid) |
| PCldTop_QC | 16-bit unsigned integer | AIRSTrack (= 3) * AIRSXTrack (= 3) * Cloud (= 2) | Quality Control for PCldTop.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| PCldTopErr | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) * Cloud (= 2) | Error estimate for PCldTop. |
| TCldTop | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) * Cloud (= 2) | Cloud top temperature in Kelvins (in order of increasing pressure. Only first nCld elements are valid) |
| TCldTop_QC | 16-bit unsigned integer | AIRSTrack (= 3) * AIRSXTrack (= 3) * Cloud (= 2) | Quality Control for TCldTop.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| TCldTopErr | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) * Cloud (= 2) | Error estimate for TCldTop. |
| nCld | 32-bit integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Number of cloud layers in each of the 9 spots |
| **Ozone Retrievals** | | | |
| totO3Std | 32-bit floating-point | None | Total ozone burden (Dobson units) |
| totO3Std_QC | 16-bit unsigned integer | None | Quality Control for totO3Std.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| totO3StdErr | 32-bit floating-point | None | Error estimate for totO3Std |
| O3VMRStd | 32-bit floating-point | StdPressureLay (= 28) | Ozone Volume Mixing Ratio on standard layers (ppv) |
| O3VMRStd_QC | 16-bit unsigned integer | StdPressureLay (= 28) | Quality Control for O3VMRStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |

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| O3VMRStdErr | 32-bit floating-point | StdPressureLay (= 28) | Error estimate for O3VMRStd |
| O3VMRLevStd | 32-bit floating-point | StdPressureLev (= 28) | Ozone Volume Mixing Ratio at standard levels (ppv) |
| O3VMRLevStd_QC | 16-bit unsigned integer | StdPressureLev (= 28) | Quality Control for O3VMRLevStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| O3VMRLevStdErr | 32-bit floating-point | StdPressureLev (= 28) | Error estimate for O3VMRLevStd |
| num_O3_Func | 16-bit integer | None | Number of valid entries in each dimension of O3_ave_kern. |
| O3_verticality | 32-bit floating-point | O3Func (= 9) | Sum of the rows of O3_ave_kern. |
| O3_dof | 32-bit floating-point | None | Measure of the amount of information in O3 retrieval (deg of freedom). |
| **Carbon Monoxide Retrievals** | | | |
| CO_total_column | 32-bit floating-point | None | Retrieved total column CO (molecules/cm2). |
| CO_total_column_QC | 16-bit unsigned integer | None | Quality Control for CO_total_column.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| COVMRLevStd | 32-bit floating-point | StdPressureLev (= 28) | CO Volume Mixing Ratio at standard levels (ppv) |
| COVMRLevStd_QC | 16-bit unsigned integer | StdPressureLev (= 28) | Quality Control for COVMRLevStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| COVMRLevStdErr | 32-bit floating-point | StdPressureLev (= 28) | Error estimate for COVMRLevStd |
| num_CO_Func | 16-bit integer | None | Number of valid entries in each dimension of CO_ave_kern. |
| CO_verticality | 32-bit floating-point | COFunc (= 9) | Sum of the rows of CO_ave_kern. |
| CO_dof | 32-bit floating- | None | Measure of the amount of information in CO retrieval (deg of |

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| | point | | freedom). |
| **Methane Retrievals** | | | |
| CH4_total_column | 32-bit floating-point | None | Retrieved total column CH4 (molecules/cm2). |
| CH4_total_column_QC | 16-bit unsigned integer | None | Quality Control for CH4_total_column.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| CH4VMRLevStd | 32-bit floating-point | StdPressureLev (= 28) | CH4 Volume Mixing Ratio at standard levels (ppv) |
| CH4VMRLevStd_QC | 16-bit unsigned integer | StdPressureLev (= 28) | Quality Control for CH4VMRLevStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| CH4VMRLevStdErr | 32-bit floating-point | StdPressureLev (= 28) | Error estimate for CH4VMRLevStd |
| num_CH4_Func | 16-bit integer | None | Number of valid entries in each dimension of CH4_ave_kern. |
| CH4_verticality_10func | 32-bit floating-point | CH4Func (= 10) | Sum of the rows of CH4_ave_kern. |
| CH4_dof | 32-bit floating-point | None | Measure of the amount of information in CH4 retrieval (deg of freedom). |
| **Outgoing Longwave Radiation Retrievals** | | | |
| olr | 32-bit floating-point | None | Outgoing Longwave Radiation Flux integrated over 2 to 2800 cm**-1 (Watts/m**2) |
| olr_QC | 16-bit unsigned integer | None | Quality Control for olr.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| olr3x3 | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Outgoing Longwave Radiation Flux integrated over 2 to 2800 cm**-1 (per 15 km AIRS FOV) (Watts/m**2) |
| olr3x3_QC | 16-bit unsigned integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Quality Control for olr3x3.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| olr_err | 32-bit floating-point | None | Error estimate for olr (Watts/m**2) |
| clrolr | 32-bit | None | Clear-sky Outgoing Longwave |

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|---|---|---|---|
| | floating-point | | Radiation Flux integrated over 2 to 2800 cm**-1 (Watts/m**2) |
| clrolr_QC | 16-bit unsigned integer | None | Quality Control for clrolr.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| clrolr_err | 32-bit floating-point | None | Error estimate for clrolr (Watts/m**2) |
| **Geolocation QA** | | | |
| ftptgeoqa | 32-bit unsigned integer | None | See Appendix D |
| zengeoqa | 16-bit unsigned integer | None | See Appendix D |
| demgeoqa | 16-bit unsigned integer | None | See Appendix D |
| **Miscellaneous** | | | |
| dust_flag | 16-bit integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Flag telling whether dust was detected in this scene;<br>1: Dust detected;<br>0: Dust not detected;<br>-1: Dust test not valid because of land;<br>-2: Dust test not valid because of high latitude;<br>-3: Dust test not valid because of suspected cloud;<br>-4: Dust test not valid because of bad input data |
| all_spots_avg | 8-bit integer | None | 1: the cloud clearing step judged the scene to be clear enough that it averaged all spots' radiances;<br>0: cloud clearing was applied to the radiances;<br>-1/255: cloud clearing not attempted |
| retrieval_type | 8-bit integer | None | Deprecated -- use Xxx_QC flags. Retrieval type:;<br>0 for full retrieval;<br>10 for MW + final succeeded, initial retrieval failed;<br>20 for MW + initial succeeded, final failed;<br>30 for only MW stage succeeded, initial + final retrieval failed;<br>40 for MW + initial succeeded, final cloud-clearing failed;<br>50 for only MW stage succeeded, |

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| | | | initial + final cloud-clearing failed;<br>100 for no retrieval; |
| SurfClass | 8-bit integer | None | Surface class used in physical retrieval, from microwave (MW) and/or infrared (IR). Identical to MWSurfClass when MW is used:;<br>0 for coastline (Liquid water covers 50-99% of area);<br>1 for land (Liquid water covers < 50% of area);<br>2 for ocean (Liquid water covers > 99% of area);<br>3 for sea ice (Indicates high MW emissivity when MW information is used);<br>4 for sea ice (Indicates low MW emissivity. This value is only produced when MW information is used.);<br>5 for snow (Indicates higher-frequency MW scattering when MW information is used);<br>6 for glacier/snow (Indicates very low-frequency MW scattering. This value is only produced when MW information is used.);<br>7 for snow (Indicates lower-frequency MW scattering. This value is only produced when MW information is used.);<br>-1 for unknown |
| **Microwave Dependent** | | | |
| TAirMWOnlyStd | 32-bit floating-point | StdPressureLev (= 28) | Atmospheric Temperature retrieved using only MW information (no IR) at StdPressLev in Kelvins. |
| TAirMWOnlyStd_QC | 16-bit unsigned integer | StdPressureLev (= 28) | Quality Control for TAirMWOnlyStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| MWSurfClass | 8-bit integer | None | Surface class from microwave (MW) information:;<br>0 for coastline (Liquid water covers 50-99% of area);<br>1 for land (Liquid water covers < 50% of area);<br>2 for ocean (Liquid water covers > 99% of area);<br>3 for sea ice (High MW emissivity);<br>4 for sea ice (Low MW emissivity);<br>5 for snow (Higher-frequency MW scattering); |

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| | | | 6 for glacier/snow (Very low-frequency MW scattering);<br>7 for snow (Lower-frequency MW scattering);<br>-1 for unknown (not attempted) |
| sfcTbMWStd | 32-bit floating-point | MWHingeSurf (= 7) | Microwave surface brightness (Kelvins) (Emitted radiance only, reflected radiance not included. Product of MW only algorithm) |
| sfcTbMWStd_QC | 16-bit unsigned integer | MWHingeSurf (= 7) | Quality Control for sfcTbMWStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| EmisMWStd | 32-bit floating-point | MWHingeSurf (= 7) | Spectral MW emissivity at the 7 MW frequencies listed for dimension MWHingeSurf (Product of MW only algorithm) |
| EmisMWStd_QC | 16-bit unsigned integer | MWHingeSurf (= 7) | Quality Control for EmisMWStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| EmisMWStdErr | 32-bit floating-point | MWHingeSurf (= 7) | Error estimate for EmisMWStd |
| totH2OMWOnlyStd | 32-bit floating-point | None | Total precipitable water vapor from MW-only retrieval (no IR information used) (kg / m**2) |
| totH2OMWOnlyStd_QC | 16-bit unsigned integer | None | Quality Control for totH2OMWOnlyStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| GP_Height_MWOnly | 32-bit floating-point | StdPressureLev (= 28) | Geopotential Heights from MW-Only retrieval (No IR information used) at StdPressureLev (m above mean sea level) |
| GP_Height_MWOnly_QC | 16-bit unsigned integer | StdPressureLev (= 28) | Quality Control for GP_Height_MWOnly.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| MW_ret_used | 8-bit integer | None | MW-only final retrieval used |
| totCldH2OStd | 32-bit floating-point | None | Total cloud liquid water in kg/m**2 |
| totCldH2OStd_QC | 16-bit unsigned integer | None | Quality Control for totCldH2OStd;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |

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| totCldH2OStdErr | 32-bit floating-point | None | Error estimate for totCldH2OStd |

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# A1-10. L2 Standard Cloud-Cleared Radiance Product Interface Specification

Interface Specification Version 6.0.7.0
2012-08-28

ESDT ShortNames = "AIRI2CCF"", “AIRS2CCF”, “AIRH2CCF”

DOIs = “10.5067/AQUA/AIRS/DATA204”, “10.5067/AQUA/AIRS/DATA205”, “10.5067/AQUA/AIRS/DATA206”

Swath Name = "L2_Standard_cloud-cleared_radiance_product"

Level = "Level2"

# Footprints = 30

# scanlines per scanset = 1

## Dimensions

**These fields define all dimensions that can be used for HDF-EOS swath fields.**

**The names "GeoTrack" and "GeoXTrack" have a special meaning for this document: "Cross-Track" data fields have a hidden dimension of "GeoXTrack"; "Along-Track" data fields have a hidden dimension of "GeoTrack"; "Full Swath Data Fields have hidden dimensions of both "GeoTrack" and "GeoXTrack".**

| Name | Value | Explanation |
|---|---|---|
| GeoXTrack | 30 | Dimension across track for footprint positions. Same as number of footprints per scanline. -- starting at the left and increasing towards the right as you look along the satellite's path |
| GeoTrack | # of scan lines in swath | Dimension along track for footprint positions. Same as number of scanlines in granule. Parallel to the satellite's path, increasing with time. (Nominally 45) |
| Channel | 2378 | Dimension of channel array (Channels are generally in order of increasing wavenumber, but because frequencies can vary and because all detectors from a physical array of detector elements (a "module") are always grouped together there are sometimes small reversals in frequency order where modules overlap.) |
| AIRSXTrack | 3 | The number of AIRS cross-track spots per AMSU-A spot. Direction is the same as GeoXTrack -- starting at the left and increasing towards the right as you look along the satellite's path |
| AIRSTrack | 3 | The number of AIRS along-track spots per AMSU-A spot. Direction is the same as GeoTrack -- parallel to the satellite's path, increasing with time |
| Module | 17 | Number of modules on the focal plane in which airs channels are |

| | | |
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| | | grouped. The order is M-01a, M-02a, M-01b, M-02b, M-04d, M-04c, M-03, M-04b, M-04a, M-05, M-06, M-07, M-08, M-09, M-10, M-11, M-12. |

## Geolocation Fields

**These fields appear for every footprint (GeoTrack * GeoXTrack times) and correspond to footprint center coordinates and "shutter" time.**

| Name | Explanation |
|---|---|
| Latitude | Footprint boresight geodetic Latitude in degrees North (-90.0 ... 90.0) |
| Longitude | Footprint boresight geodetic Longitude in degrees East (-180.0 ... 180.0) |
| Time | Footprint "shutter" TAI Time: floating-point elapsed seconds since Jan 1, 1993 |

## Attributes

**These fields appear only once per granule and use the HDF-EOS "Attribute" interface**

| Name | Type | Explanation |
|---|---|---|
| processing_level | string of 8-bit characters | Zero-terminated character string denoting processing level ("Level2") |
| instrument | string of 8-bit characters | Zero-terminated character string denoting instrument ("AIRS") |
| DayNightFlag | string of 8-bit characters | Zero-terminated character string set to "Night" when the subsatellite points at the beginning and end of a granule are both experiencing night according to the "civil twilight" standard (center of refracted sun is below the horizon). It is set to "Day" when both are experiencing day, and "Both" when one is experiencing day and the other night. "NA" is used when a determination cannot be made. |
| AutomaticQAFlag | string of 8-bit characters | Zero-terminated character string denoting granule data quality: (Always "Passed", "Failed", or "Suspect") |
| NumTotalData | 32-bit integer | Total number of expected scene footprints |
| NumProcessData | 32-bit integer | Number of scene footprints which are present and can be processed routinely (state = 0) |
| NumSpecialData | 32-bit integer | Number of scene footprints which are present and can be processed only as a special test (state = 1) |
| NumBadData | 32-bit integer | Number of scene footprints which are present but cannot be processed (state = 2) |
| NumMissingData | 32-bit integer | Number of expected scene footprints which are not present (state = 3) |
| NumLandSurface | 32-bit integer | Number of scene footprints for which the surface is more than 90% land |
| NumOceanSurface | 32-bit integer | Number of scene footprints for which the surface is less than 10% land |
| node_type | string of 8- | Zero-terminated character string denoting whether granule |

| | | |
|---|---|---|
| | bit characters | is ascending, descending, or pole-crossing: ("Ascending" and "Descending" for entirely ascending or entirely descending granules, or "NorthPole" or "SouthPole" for pole-crossing granules. "NA" when determination cannot be made.) |
| start_year | 32-bit integer | Year in which granule started, UTC (e.g. 1999) |
| start_month | 32-bit integer | Month in which granule started, UTC (1 ... 12) |
| start_day | 32-bit integer | Day of month in which granule started, UTC (1 ... 31) |
| start_hour | 32-bit integer | Hour of day in which granule started, UTC (0 ... 23) |
| start_minute | 32-bit integer | Minute of hour in which granule started, UTC (0 ... 59) |
| start_sec | 32-bit floating-point | Second of minute in which granule started, UTC (0.0 ... 59.0) |
| start_orbit | 32-bit integer | Orbit number of mission in which granule started |
| end_orbit | 32-bit integer | Orbit number of mission in which granule ended |
| orbit_path | 32-bit integer | Orbit path of start orbit (1 ... 233 as defined by EOS project) |
| start_orbit_row | 32-bit integer | Orbit row at start of granule (1 ... 248 as defined by EOS project) |
| end_orbit_row | 32-bit integer | Orbit row at end of granule (1 ... 248 as defined by EOS project) |
| granule_number | 32-bit integer | Number of granule within day (1 ... 240) |
| num_scansets | 32-bit integer | Number of scansets in granule (1 ... 45) |
| num_scanlines | 32-bit integer | Number of scanlines in granule (3 * num_scansets) |
| start_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees North (-90.0 ... 90.0) |
| start_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees East (-180.0 ... 180.0) |
| start_Time | 64-bit floating-point | TAI Time at start of granule (floating-point elapsed seconds since start of 1993) |
| end_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees North (-90.0 ... 90.0) |
| end_Longitude | 64-bit floating- | Geodetic Longitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees |

| | | |
|---|---|---|
| | point | East (-180.0 ... 180.0) |
| end_Time | 64-bit floating-point | TAI Time at end of granule (floating-point elapsed seconds since start of 1993) |
| eq_x_longitude | 32-bit floating-point | Longitude of spacecraft at southward equator crossing nearest granule start in degrees East (-180.0 ... 180.0) |
| eq_x_tai | 64-bit floating-point | Time of eq_x_longitude in TAI units (floating-point elapsed seconds since start of 1993) |
| LonGranuleCen | 16-bit integer | Geodetic Longitude of the center of the granule in degrees East (-180 ... 180) |
| LatGranuleCen | 16-bit integer | Geodetic Latitude of the center of the granule in degrees North (-90 ... 90) |
| LocTimeGranuleCen | 16-bit integer | Local solar time at the center of the granule in minutes past midnight (0 ... 1439) |
| num_fpe | 16-bit integer | Number of floating point errors |
| orbitgeoqa | 32-bit unsigned integer | See Appendix D |
| num_satgeoqa | 16-bit integer | Number of scans with problems in satgeoqa |
| num_glintgeoqa | 16-bit integer | Number of scans with problems in glintgeoqa |
| num_moongeoqa | 16-bit integer | Number of scans with problems in moongeoqa |
| num_ftptgeoqa | 16-bit integer | Number of footprints with problems in ftptgeoqa |
| num_zengeoqa | 16-bit integer | Number of footprints with problems in zengeoqa |
| num_demgeoqa | 16-bit integer | Number of footprints with problems in demgeoqa |
| CalGranSummary | 8-bit unsigned integer | Bit field. Bitwise OR of CalChanSummary, over all channels with ExcludedChans < 3.;<br>Zero means all these channels were well calibrated, for all scanlines.;<br>Bit 7: (MSB, value 128) scene over/underflow;<br>Bit 6: (value 64) anomaly in offset calculation;<br>Bit 5: (value 32) anomaly in gain calculation;<br>Bit 4: (value 16) pop detected with no offset anomaly;<br>Bit 3: (value 8) noise out of bounds;<br>Bit 2: (value 4) anomaly in spectral calibration;<br>Bit 1: (value 2) Telemetry;<br>Bit 0: (LSB, value 1) unused (reserved); |
| DCR_scan | 16-bit integer | Level-1B scanline number following (first) DC-Restore. 0 for no DC-Restore. DCR_scan refers to Level-1 8/3-second scans, not Level-2 8-second scansets. DCR_scan = 1 refers to an event before the first scan of the first scanset. |

| | | |
|---|---|---|
| | | DCR_scan = 2 or 3 refer to events within the first scanset, DCR_scan = 4 to events between the first and second scansets. |
| granules_present_L1B | string of 8-bit characters | Zero-terminated character string denoting which adjacent granules were available for smoothing during Level-1B calibration processing. ("All" for both previous & next, "Prev" for previous but not next, "Next" for next but not previous, "None" for neither previous nor next) |

## Per-Granule Data Fields

### These fields appear only once per granule and use the HDF-EOS "Field" interface

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| nominal_freq | 32-bit floating-point | Channel (= 2378) | Nominal frequencies (in cm**-1) of each channel |
| CalChanSummary | 8-bit unsigned integer | Channel (= 2378) | Bit field. Bitwise OR of CalFlag, by channel, over all scanlines. Noise threshold and spectral quality added.;<br>Zero means the channel was well calibrated for all scanlines;<br>Bit 7 (MSB): scene over/underflow;<br>Bit 6: (value 64) anomaly in offset calculation;<br>Bit 5: (value 32) anomaly in gain calculation;<br>Bit 4: (value 16) pop detected with no offset anomaly;<br>Bit 3: (value 8) noise out of bounds;<br>Bit 2: (value 4) anomaly in spectral calibration;<br>Bit 1: (value 2) Telemetry;<br>Bit 0: (LSB, value 1) unused (reserved); |
| ExcludedChans | 8-bit unsigned integer | Channel (= 2378) | An integer 0-6, indicating A/B detector weights. Used in L1B processing.;<br>0 - A weight = B weight. Probably better that channels with state > 2;<br>1 - A-side only. Probably better that channels with state > 2;<br>2 - B-side only. Probably better that channels with state > 2;<br>3 - A weight = B weight. Probably better than channels with state = 6;<br>4 - A-side only. Probably better than channels with state = 6;<br>5 - B-side only. Probably better than channels with state = 6;<br>6 - Has anomalous gain performance. Probably not usable. |
| NeN_L1B | 32-bit floating-point | Channel (= 2378) | Level-1B Noise-equivalent Radiance (radiance units) for an assumed 250K scene. Note that effective noise on cloud-cleared radiances will be modified. |

| | | | |
|---|---|---|---|
| NeN_L1B_Static | 32-bit floating-point | Channel (= 2378) | Expected Noise-equivalent Radiance (radiance units) for an assumed 250K scene. This static estimate comes from a channel properties file and reflects nominal conditions for an epoch of months. It is a more stable value than NeN_L1B but does not reflect recent or transient changes to noise levels. |

## Along-Track Data Fields

### These fields appear once per scanline (GeoTrack times)

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| satheight | 32-bit floating-point | None | Satellite altitude at nadirTAI in km above reference ellipsoid (e.g. 725.2) |
| satroll | 32-bit floating-point | None | Satellite attitude roll angle at nadirTAI (-180.0 ... 180.0 angle about the +x (roll) ORB axis, +x axis is positively oriented in the direction of orbital flight completing an orthogonal triad with y and z.) |
| satpitch | 32-bit floating-point | None | Satellite attitude pitch angle at nadirTAI (-180.0 ... 180.0 angle about +y (pitch) ORB axis. +y axis is oriented normal to the orbit plane with the positive sense opposite to that of the orbit's angular momentum vector H.) |
| satyaw | 32-bit floating-point | None | Satellite attitude yaw angle at nadirTAI (-180.0 ... 180.0 angle about +z (yaw) axis. +z axis is positively oriented Earthward parallel to the satellite radius vector R from the spacecraft center of mass to the center of the Earth.) |
| glintlat | 32-bit floating-point | None | Solar glint geodetic latitude in degrees North at nadirTAI (-90.0 ... 90.0) |
| glintlon | 32-bit floating-point | None | Solar glint geodetic longitude in degrees East at nadirTAI (-180.0 ... 180.0) |
| nadirTAI | 64-bit floating-point | None | TAI time at which instrument is nominally looking directly down. (between footprints 15 & 16 for AMSU or between footprints 45 & 46 for AIRS/Vis & HSB) (floating-point elapsed seconds since start of 1993) |
| sat_lat | 64-bit floating-point | None | Satellite geodetic latitude in degrees North (-90.0 ... 90.0) |
| sat_lon | 64-bit floating-point | None | Satellite geodetic longitude in degrees East (-180.0 ... 180.0) |
| scan_node_type | 8-bit integer | None | 'A' for ascending, 'D' for descending, 'E' when an error is encountered in trying to determine a value. |

| | | | |
|---|---|---|---|
| satgeoqa | 32-bit unsigned integer | None | See Appendix D |
| glintgeoqa | 16-bit unsigned integer | None | See Appendix D |
| moongeoqa | 16-bit unsigned integer | None | See Appendix D |
| CalFlag | 8-bit unsigned integer | Channel (= 2378) | Bit field, by channel, for calibration the current scanset.;<br>Zero means the channel was well calibrated, for this scanset.;<br>Bit 7: (MSB, value 128) scene over/underflow;<br>Bit 6: (value 64) anomaly in offset calculation;<br>Bit 5: (value 32) anomaly in gain calculation;<br>Bit 4: (value 16) pop detected;<br>Bit 3: (value 8) DCR Occurred;<br>Bit 2: (value 4) Moon in View;<br>Bit 1: (value 2) telemetry out of limit condition;<br>Bit 0: (LSB, value 1) cold scene noise |
| CalScanSummary | 8-bit unsigned integer | None | Bit field. Bitwise OR of CalFlag over the good channel list (see ExcludedChans).;<br>Zero means all "good" channels were well calibrated for this scanset;<br>Bit 7: (MSB, value 128) scene over/underflow;<br>Bit 6: (value 64) anomaly in offset calculation;<br>Bit 5: (value 32) anomaly in gain calculation;<br>Bit 4: (value 16) pop detected;<br>Bit 3: (value 8) DCR Occurred;<br>Bit 2: (value 4) Moon in View;<br>Bit 1: (value 2) telemetry out of limit condition;<br>Bit 0: (LSB, value 1) cold_scene noise |
| orbit_phase_deg | 32-bit floating-point | None | Orbit phase in degrees. 0.0 is nighttime equator crossing. 90.0 is near the south pole. 180.0 is near the daytime equator crossing. 270.0 is near the north pole. [0.0, 360.0] |
| shift_y0 | 32-bit floating-point | Module (= 17) | Focal plane shift in the y (spectral dispersion) direction relative to prelaunch nominal. (microns) |
| scan_freq | 32-bit floating-point | Channel (= 2378) | Dynamic frequencies (in cm**-1) of each channel for each scan |

## Full Swath Data Fields

### These fields appear for every footprint of every scanline in the granule (GeoTrack * GeoXTrack times)

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| radiances | 32-bit | Channel (= | Cloud-cleared radiances for each |

| | | | |
|---|---|---|---|
| | floating-point | 2378) | channel in milliWatts/m**2/cm**-1/steradian |
| radiances_QC | 16-bit unsigned integer | Channel (= 2378) | Quality Control for radiances.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| radiance_err | 32-bit floating-point | Channel (= 2378) | Error estimate for radiances (milliWatts/m**2/cm**-1/steradian) |
| CldClearParam | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Cloud clearing parameter Eta. Positive values are cloudier than average for the FOR, negative values are clearer. |
| scanang | 32-bit floating-point | None | Scanning angle of the central AIRS instrument field-of-view with respect to the spacecraft (-180.0 ... 180.0, negative at start of scan, 0 at nadir) |
| satzen | 32-bit floating-point | None | Spacecraft zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| satazi | 32-bit floating-point | None | Spacecraft azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| solzen | 32-bit floating-point | None | Solar zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| solazi | 32-bit floating-point | None | Solar azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| sun_glint_distance | 16-bit integer | None | Distance (km) from footprint center to location of the sun glint (-9999 for unknown, 30000 for no glint visible because spacecraft is in Earth's shadow) |
| topog | 32-bit floating-point | None | Mean topography in meters above reference ellipsoid |
| topog_err | 32-bit floating-point | None | Error estimate for topog |
| landFrac | 32-bit floating-point | None | Fraction of spot that is land (0.0 ... 1.0) |
| landFrac_err | 32-bit floating- | None | Error estimate for landFrac |

| | | | |
|---|---|---|---|
| | point | | |
| ftptgeoqa | 32-bit unsigned integer | None | See Appendix D |
| zengeoqa | 16-bit unsigned integer | None | See Appendix D |
| demgeoqa | 16-bit unsigned integer | None | See Appendix D |
| Doppler_shift_ppm | 32-bit floating-point | None | Doppler shift for this footprint in parts per million. |
| dust_flag | 16-bit integer | None | Flag telling whether dust was detected in any of the 9 Level-1B IR fields of view that make up this scene;<br>1: Dust detected in at least one contributing FOV;<br>0: Dust test valid in at least one contributing IR FOV but dust not detected in any of the valid contributing IR FOVs;<br>-1: Dust test not valid for any contributing IR FOV (land, poles, cloud, problem with inputs) |
| CC_noise_eff_amp_factor | 32-bit floating-point | None | Effective amplification of noise in IR window channels due to extrapolation in cloud clearing and uncertainty of clear state. (< 1.0 for noise reduction, >1.0 for noise amplification, -9999.0 for unknown) |
| CC1_noise_eff_amp_factor | 32-bit floating-point | None | Equivalent of CC_noise_eff_amp_factor but from the first attempt at cloud clearing |
| CC1_Resid | 32-bit floating-point | None | Internal retrieval quality indicator -- residual between the first cloud cleared radiances for channels used in the determination and the radiances calculated from the best estimate of clear, in K |
| CCfinal_Resid | 32-bit floating-point | None | Internal retrieval quality indicator -- residual between the final cloud cleared radiances for channels used in the determination and the radiances calculated from the best estimate of clear, in K |
| TotCld_4_CCfinal | 32-bit floating-point | None | Internal retrieval quality indicator -- total cloud fraction estimated before final cloud clearing (as seen from above), dimensionless between zero and one |
| CCfinal_Noise_Amp | 32-bit | None | Internal retrieval quality indicator -- noise |

| | | | |
|---|---|---|---|
| | floating-point | | amplification factor from cloud clearing because of extrapolation, dimensionless. Note: the name is misleading: this is the value after the second cloud clearing iteration, not the last. |
| invalid | 8-bit integer | None | Profile is not valid |
| all_spots_avg | 8-bit integer | None | 1: the cloud clearing step judged the scene to be clear enough that it averaged all spots' radiances;<br>0: cloud clearing was applied to the radiances;<br>-1/255: cloud clearing not attempted |
| MW_ret_used | 8-bit integer | None | MW-only final retrieval used |
| bad_clouds | 8-bit integer | None | invalid cloud parameters |
| retrieval_type | 8-bit integer | None | Deprecated -- use Xxx_QC flags.<br>Retrieval type:;<br>0 for full retrieval;<br>10 for MW + final succeeded, initial retrieval failed;<br>20 for MW + initial succeeded, final failed;<br>30 for only MW stage succeeded, initial + final retrieval failed;<br>40 for MW + initial succeeded, final cloud-clearing failed;<br>50 for only MW stage succeeded, initial + final cloud-clearing failed;<br>100 for no retrieval; |

# A1-11. L2 Support Atmospheric/Surface Product Interface Specification

Interface Specification Version 6.0.7.0
2012-08-28

ESDT ShortNames = "AIRX2SUP", “AIRS2SUP”, “AIRH2SUP”

DOIs = “10.5067/AQUA/AIRS/DATA207”, “10.5067/AQUA/AIRS/DATA208”, “10.5067/AQUA/AIRS/DATA209”

Swath Name = "L2_Support_atmospheric&surface_product"

Level = "Level2"

# Footprints = 30

# scanlines per scanset = 1

## Dimensions

**These fields define all dimensions that can be used for HDF-EOS swath fields.**

**The names "GeoTrack" and "GeoXTrack" have a special meaning for this document: "Cross-Track" data fields have a hidden dimension of "GeoXTrack"; "Along-Track" data fields have a hidden dimension of "GeoTrack"; "Full Swath Data Fields have hidden dimensions of both "GeoTrack" and "GeoXTrack".**

| Name | Value | Explanation |
|---|---|---|
| GeoXTrack | 30 | Dimension across track for footprint positions. Same as number of footprints per scanline. -- starting at the left and increasing towards the right as you look along the satellite's path |
| GeoTrack | # of scan lines in swath | Dimension along track for footprint positions. Same as number of scanlines in granule. Parallel to the satellite's path, increasing with time. (Nominally 45) |
| StdPressureLev | 28 | Number of standard pressure altitude levels (from bottom of the atmosphere up). |
| AIRSXTrack | 3 | The number of AIRS cross-track spots per AMSU-A spot. Direction is the same as GeoXTrack -- starting at the left and increasing towards the right as you look along the satellite's path |
| AIRSTrack | 3 | The number of AIRS along-track spots per AMSU-A spot. Direction is the same as GeoTrack -- parallel to the satellite's |

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|---|---|---|
| | | path, increasing with time |
| Cloud | 2 | Cloud layer dimension in order of increasing pressure. Only first nCld or numCloud elements are valid |
| ChanAMSUA | 15 | Dimension of AMSU-A Channel array;<br>Channel 1: 23.8 GHz;<br>Ch 2: 31.4 GHz;<br>Ch 3: 50.3 GHz;<br>Ch 4: 52.8 GHz;<br>Ch 5: 53.596 +/- 0.115 GHz;<br>Ch 6: 54.4 GHz;<br>Ch 7: 54.94 GHz;<br>Ch 8: 55.5 GHz;<br>Ch 9: f0;<br>Ch 10: f0 +/- 0.217 GHz Ch 11: f0 +/- df +/- 48 MHz;<br>Ch 12: f0 +/- df +/- 22 MHz;<br>Ch 13: f0 +/- df +/- 10 MHz;<br>Ch 14: f0 +/- df +/- 4.5 MHz;<br>Ch 15: 89 GHz;<br>(f0 = 57290.344 MHz;<br>df = 322.4 MHz) |
| ChanHSB | 5 | Dimension of HSB Channel array;<br>Channel 1: Deleted 89.0 GHz channel: always invalid;<br>Ch 2: 150.0 GHz;<br>Ch 3: f0 +/- 1.0 GHz;<br>Ch 4: f0 +/- 3.0 GHz;<br>Ch 5: f0 +/- 7.0 GHz;<br>(f0 = 183.31 GHz) |
| MWHingeSurf | 7 | Number of standard frequency hinge points in Microwave surface emissivity and surface brightness. Frequencies are 23.8, 31.4, 50.3, 52.8, 89.0, 150.0, 183.31 GHz respectively.Values are also found in field MWHingeSurfFreqGHz. |
| H2OFunc | 11 | Functions on which water vapor retrieval is calculated |
| O3Func | 9 | Functions on which ozone retrieval is calculated |
| COFunc | 9 | Functions on which carbon monoxide retrieval is calculated |
| CH4Func | 10 | Functions on which methane retrieval is calculated |
| HingeSurf | 100 | Maximum number of frequency hinge points in IR surface emissivity |
| H2OPressureLev | 15 | Number of water vapor pressure altitude levels (from bottom of the atmosphere up). |
| XtraPressureLev | 100 | Number of pressure altitude layers in high vertical resolution support products (from top of the atmosphere down). nSurfSup is the 1-based index of the last valid level for a given profile. Any levels beyond this are below the surface. Since the actual surface will not be be exactly at this level, it will be necessary to extrapolate or interpolate to get precise surface values. See entries for specific fields for more details. |
| XtraPressureLay | 100 | Number of pressure altitude layers in high vertical resolution support products (Always equal to XtraressureLev: first layer goes from the top of the atmosphere to level 1). nSurfSup is the 1-based index of the last valid layer for a given profile. Any |

| | | |
|---|---|---|
| | | layers beyond this are below the surface. Since the actual surface will not be be exactly at the bottom of this layer, it will be necessary to extrapolate or interpolate to get total amounts for surface layers. See entries for specific fields for more details. |
| HingeCloud | 7 | Frequency hinge points in cloud emissivity in order of increasing frequency. Only first numHingeCloud elements are valid |
| HingeSurfInit | 50 | Maximum number of frequency hinge points in IR surface emissivity from initial regression |
| ScoresBand | 10 | The number of IR frequency bands for which Initial_CC_subscores are calculated. Band limits are (in cm^-1): 645., 704., 800., 1000., 1200., 2200., 2304., 2382., 2390., 2400., 2600. |
| MODISEmisBand | 6 | MODIS bands for IR emissivity first guess: 833.33, 909.09, 1169.6, 2469.1, 2531.6, and 2666.7 cm**-1. |
| MODISEmis10Hinge | 10 | MODIS hinge points for IR emissivity first guess: 699.30, 826.45, 925.93, 1075.27, 1204.82, 1315.79, 1724.14, 2000.0, 2325.58, and 2777.78 cm**-1. |
| MODISEmisQualLevels | 4 | MODIS emissivity quality levels:;<br>average emissivity error <= 0.01;<br>average emissivity error <= 0.02;<br>average emissivity error <= 0.04;<br>average emissivity error > 0.04 |
| MODISLSTQualLevels | 4 | MODIS land surface temperature quality levels:;<br>average LST error <= 1 K;<br>average LST error <= 2 K;<br>average LST error <= 3 K;<br>average LST error > 3 K |
| TempFunc | 23 | Functions on which temperature retrieval is calculated |
| Channel | 2378 | Dimension of channel array (Channels are generally in order of increasing wavenumber, but because frequencies can vary and because all detectors from a physical array of detector elements (a "module") are always grouped together there are sometimes small reversals in frequency order where modules overlap.) |
| Module | 17 | Number of modules on the focal plane in which airs channels are grouped. The order is M-01a, M-02a, M-01b, M-02b, M-04d, M-04c, M-03, M-04b, M-04a, M-05, M-06, M-07, M-08, M-09, M-10, M-11, M-12. |
| OLRBand | 16 | Spectral bands used in OLR (cm-1):;<br>1 10 - 350;<br>2 350 - 500;<br>3 500 - 630;<br>4 630 - 700;<br>5 700 - 820;<br>6 820 - 980;<br>7 980 - 1080;<br>8 1080 - 1180;<br>9 1180 - 1390;<br>10 1390 - 1480; |

| | | |
|---|---|---|
| | | 11 1480 - 1800;<br>12 1800 - 2080;<br>13 2080 - 2250;<br>14 2250 - 2380;<br>15 2380 - 2600;<br>16 2600 - 3250 |
| SccnnBtCorr | 2 | Channels reported for the brightness temperature correction in cloud clearing in SCCNN |

## Geolocation Fields

### These fields appear for every footprint (GeoTrack * GeoXTrack times) and correspond to footprint center coordinates and "shutter" time.

| Name | Explanation |
|---|---|
| Latitude | Footprint boresight geodetic Latitude in degrees North (-90.0 ... 90.0) |
| Longitude | Footprint boresight geodetic Longitude in degrees East (-180.0 ... 180.0) |
| Time | Footprint "shutter" TAI Time: floating-point elapsed seconds since Jan 1, 1993 |

## Attributes

### These fields appear only once per granule and use the HDF-EOS "Attribute" interface

| Name | Type | Explanation |
|---|---|---|
| processing_level | string of 8-bit characters | Zero-terminated character string denoting processing level ("Level2") |
| instrument | string of 8-bit characters | Zero-terminated character string denoting instrument ("AIRS") |
| DayNightFlag | string of 8-bit characters | Zero-terminated character string set to "Night" when the subsatellite points at the beginning and end of a granule are both experiencing night according to the "civil twilight" standard (center of refracted sun is below the horizon). It is set to "Day" when both are experiencing day, and "Both" when one is experiencing day and the other night. "NA" is used when a determination cannot be made. |
| AutomaticQAFlag | string of 8-bit characters | Zero-terminated character string denoting granule data quality: (Always "Passed", "Failed", or "Suspect") |
| NumTotalData | 32-bit integer | Total number of expected scene footprints |
| NumProcessData | 32-bit integer | Number of scene footprints which are present and can be processed routinely (state = 0) |
| NumSpecialData | 32-bit integer | Number of scene footprints which are present and can be processed only as a special test (state = 1) |
| NumBadData | 32-bit integer | Number of scene footprints which are present but cannot be processed (state = 2) |
| NumMissingData | 32-bit integer | Number of expected scene footprints which are not present (state = 3) |

| | | |
|---|---|---|
| NumLandSurface | 32-bit integer | Number of scene footprints for which the surface is more than 90% land |
| NumOceanSurface | 32-bit integer | Number of scene footprints for which the surface is less than 10% land |
| node_type | string of 8-bit characters | Zero-terminated character string denoting whether granule is ascending, descending, or pole-crossing: ("Ascending" and "Descending" for entirely ascending or entirely descending granules, or "NorthPole" or "SouthPole" for pole-crossing granules. "NA" when determination cannot be made.) |
| start_year | 32-bit integer | Year in which granule started, UTC (e.g. 1999) |
| start_month | 32-bit integer | Month in which granule started, UTC (1 ... 12) |
| start_day | 32-bit integer | Day of month in which granule started, UTC (1 ... 31) |
| start_hour | 32-bit integer | Hour of day in which granule started, UTC (0 ... 23) |
| start_minute | 32-bit integer | Minute of hour in which granule started, UTC (0 ... 59) |
| start_sec | 32-bit floating-point | Second of minute in which granule started, UTC (0.0 ... 59.0) |
| start_orbit | 32-bit integer | Orbit number of mission in which granule started |
| end_orbit | 32-bit integer | Orbit number of mission in which granule ended |
| orbit_path | 32-bit integer | Orbit path of start orbit (1 ... 233 as defined by EOS project) |
| start_orbit_row | 32-bit integer | Orbit row at start of granule (1 ... 248 as defined by EOS project) |
| end_orbit_row | 32-bit integer | Orbit row at end of granule (1 ... 248 as defined by EOS project) |
| granule_number | 32-bit integer | Number of granule within day (1 ... 240) |
| num_scansets | 32-bit integer | Number of scansets in granule (1 ... 45) |
| num_scanlines | 32-bit integer | Number of scanlines in granule (1 * num_scansets) |
| start_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees North (-90.0 ... 90.0) |
| start_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees East (-180.0 ... 180.0) |
| start_Time | 64-bit floating-point | TAI Time at start of granule (floating-point elapsed seconds since start of 1993) |

| | | |
|---|---|---|
| end_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees North (-90.0 ... 90.0) |
| end_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees East (-180.0 ... 180.0) |
| end_Time | 64-bit floating-point | TAI Time at end of granule (floating-point elapsed seconds since start of 1993) |
| eq_x_longitude | 32-bit floating-point | Longitude of spacecraft at southward equator crossing nearest granule start in degrees East (-180.0 ... 180.0) |
| eq_x_tai | 64-bit floating-point | Time of eq_x_longitude in TAI units (floating-point elapsed seconds since start of 1993) |
| LonGranuleCen | 16-bit integer | Geodetic Longitude of the center of the granule in degrees East (-180 ... 180) |
| LatGranuleCen | 16-bit integer | Geodetic Latitude of the center of the granule in degrees North (-90 ... 90) |
| LocTimeGranuleCen | 16-bit integer | Local solar time at the center of the granule in minutes past midnight (0 ... 1439) |
| num_fpe | 16-bit integer | Number of floating point errors |
| orbitgeoqa | 32-bit unsigned integer | See Appendix D |
| num_satgeoqa | 16-bit integer | Number of scans with problems in satgeoqa |
| num_glintgeoqa | 16-bit integer | Number of scans with problems in glintgeoqa |
| num_moongeoqa | 16-bit integer | Number of scans with problems in moongeoqa |
| num_ftptgeoqa | 16-bit integer | Number of footprints with problems in ftptgeoqa |
| num_zengeoqa | 16-bit integer | Number of footprints with problems in zengeoqa |
| num_demgeoqa | 16-bit integer | Number of footprints with problems in demgeoqa |
| NumSO2FOVs | 16-bit unsigned integer | Number of fields-of-view (out of a nominal 1350) with a signifcant SO2 concentration based on the value of BT_diff_SO2. |
| CO_first_guess | string of 8-bit characters | Name of CO First Guess source. |
| CH4_first_guess | string of 8-bit characters | Name of CH4 First Guess source. |
| numHingeSurfInit | 32-bit | Number of IR hinge points for surface emissivity and |

| | | |
|---|---|---|
| | integer | reflectivity from initial regression (not used in retrieval) |
| nFOV_big_ang_adj | 16-bit integer | The number of FOVs with nchan_big_ang_adj over 5 |
| num_retrieval_type_000 | 16-bit integer | The number of retrievals with retrieval_type equal to 0 |
| num_retrieval_type_010 | 16-bit integer | The number of retrievals with retrieval_type equal to 10 |
| num_retrieval_type_020 | 16-bit integer | The number of retrievals with retrieval_type equal to 20 |
| num_retrieval_type_030 | 16-bit integer | The number of retrievals with retrieval_type equal to 30 |
| num_retrieval_type_040 | 16-bit integer | The number of retrievals with retrieval_type equal to 40 |
| num_retrieval_type_050 | 16-bit integer | The number of retrievals with retrieval_type equal to 50 |
| num_retrieval_type_100 | 16-bit integer | The number of retrievals with retrieval_type equal to 100 |
| NumMWStratIrRetOnly | 32-bit integer | Number of profiles in which the final product comes only from MW and stratospheric IR information (retrieval_types 20, 30, 40) |
| NumNoHSB | 32-bit integer | Number of retrieval profiles for which no HSB input data is used |
| NumNoAMSUA | 32-bit integer | Number of retrieval profiles for which no AMSU-A input data is used |
| NumNoAIRS | 32-bit integer | Number of retrieval profiles for which no AIRS-IR input data is used |
| NumNoVis | 32-bit integer | Number of retrieval profiles for which no AIRS-V/NIR input data is used |
| DCRCount | 32-bit integer | Number of times a Direct Current Restore was executed for any module |
| PopCount | 32-bit integer | Number of popcorn events within granule, i.e. number of times than an AIRS channel used in the Level 2 retrieval has suffered a sudden discontinuity in dark current |
| MoonInViewMWCount | 32-bit integer | Number of scanlines in granule with the moon in a Microwave space view (approx) |

## Per-Granule Data Fields

### These fields appear only once per granule and use the HDF-EOS "Field" interface

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| pressSupp | 32-bit floating-point | XtraPressureLev (= 100) | Support pressures (lower boundary) in hPa. |
| pressStd | 32-bit floating- | StdPressureLev (= 28) | Standard pressures in hPa (bottom of the atmosphere first) |

| | | | |
|---|---|---|---|
| | point | | |
| H2O_trapezoid_layers | 32-bit integer | H2OFunc (= 11) | Layers on which the H2O variables are defined. |
| O3_trapezoid_layers | 32-bit integer | O3Func (= 9) | Layers on which the O3 variables are defined. |
| CO_trapezoid_layers | 32-bit integer | COFunc (= 9) | Layers on which the CO variables are defined. |
| CH4_trapezoid_layers_10func | 32-bit integer | CH4Func (= 10) | Layers on which the CH4 variables are defined. |
| MWHingeSurfFreqGHz | 32-bit floating-point | MWHingeSurf (= 7) | Frequencies in GHz for MW surface parameters (SfcTbMWStd, EmisMWStd,...) |
| freqEmisInit | 32-bit floating-point | HingeSurfInit (= 50) | Frequencies for surface emissivity and reflectivity in cm-1 (in order of increasing frequency. Only first numHingeSurfInit elements are valid) |
| L1C_Reconst_Bias | 32-bit floating-point | Channel (= 2378) | Bias between reconstructed value from cleaning andL1B values. (K) |
| L1C_Reconst_Dev | 32-bit floating-point | Channel (= 2378) | Standard Deviation between reconstructed value from cleaning andL1B values. (K) |

## Along-Track Data Fields

### These fields appear once per scanline (GeoTrack times)

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| satheight | 32-bit floating-point | None | Satellite altitude at nadirTAI in km above reference ellipsoid (e.g. 725.2) |
| satroll | 32-bit floating-point | None | Satellite attitude roll angle at nadirTAI (-180.0 ... 180.0 angle about the +x (roll) ORB axis, +x axis is positively oriented in the direction of orbital flight completing an orthogonal triad with y and z.) |
| satpitch | 32-bit floating-point | None | Satellite attitude pitch angle at nadirTAI (-180.0 ... 180.0 angle about +y (pitch) ORB axis. +y axis is oriented normal to the orbit plane with the positive sense opposite to that of the orbit's angular momentum vector H.) |
| satyaw | 32-bit floating-point | None | Satellite attitude yaw angle at nadirTAI (-180.0 ... 180.0 angle about +z (yaw) axis. +z axis is positively oriented Earthward parallel to the satellite radius vector R from the spacecraft center of mass to the center of the Earth.) |
| glintlat | 32-bit floating-point | None | Solar glint geodetic latitude in degrees North at nadirTAI (-90.0 ... 90.0) |

| | | | |
|---|---|---|---|
| glintlon | 32-bit floating-point | None | Solar glint geodetic longitude in degrees East at nadirTAI (-180.0 ... 180.0) |
| nadirTAI | 64-bit floating-point | None | TAI time at which instrument is nominally looking directly down. (between footprints 15 & 16 for AMSU or between footprints 45 & 46 for AIRS/Vis & HSB) (floating-point elapsed seconds since start of 1993) |
| sat_lat | 64-bit floating-point | None | Satellite geodetic latitude in degrees North (-90.0 ... 90.0) |
| sat_lon | 64-bit floating-point | None | Satellite geodetic longitude in degrees East (-180.0 ... 180.0) |
| scan_node_type | 8-bit integer | None | 'A' for ascending, 'D' for descending, 'E' when an error is encountered in trying to determine a value. |
| satgeoqa | 32-bit unsigned integer | None | See Appendix D |
| glintgeoqa | 16-bit unsigned integer | None | See Appendix D |
| moongeoqa | 16-bit unsigned integer | None | See Appendix D |
| orbit_phase_deg | 32-bit floating-point | None | Orbit phase in degrees. 0.0 is nighttime equator crossing. 90.0 is near the south pole. 180.0 is near the daytime equator crossing. 270.0 is near the north pole. [0.0, 360.0] |
| shift_y0 | 32-bit floating-point | Module (= 17) | Focal plane shift in the y (spectral dispersion) direction relative to prelaunch nominal. (microns) |
| scan_freq | 32-bit floating-point | Channel (= 2378) | Dynamic frequencies (in cm**-1) of each channel for each scan |
| L1cProc | 8-bit unsigned integer | Channel (= 2378) | Bit field, by channel, for the current scanline. Zero means the channel was unchanged in Level-1C for this scanline.;<br>Bit 7 (MSB, value 128): unused/reserved (value 0);<br>Bit 6: (value 64) Filled for one or more spectra on this scan line. See L1cCleanReason;<br>Bit 5: (value 32) Shifted frequency;<br>Bit 4: (value 16) radiometric correction applied;<br>Bit 3: (value 8) unused/reserved (value 0);<br>Bit 2: (value 4) unused/reserved (value 0);<br>Bit 1: (value 2) unused/reserved (value 0);<br>Bit 0: (LSB, value 1) unused/reserved (value 0) |
| L1cCleanReason | 8-bit unsigned integer | Channel (= 2378) | Bit field, by channel, for the current scanline.;<br>Bit 7 (MSB, value 128): Filled for all spectra because channel is in a permanent list; |

| | | | |
|---|---|---|---|
| | | | Bit 6: (value 64) Filled for one or more spectra because of bad input value;<br>Bit 5: (value 32) Filled for all spectra because of high noise;<br>Bit 4: (value 16) Filled for all spectra because of zero or negative noise;<br>Bit 3: (value 8) Filled for one or more scan lines because of telemetry, gain, offset, or pop flag bit set in CalFlag;<br>Bit 2: (value 4) Filled for one or more spectra because channel was dynamically determined to be out of expected range;<br>Bit 1: (value 2) Filled for all spectra by command;<br>Bit 0: (LSB, value 1) unused/reserved (value 0) |

## Full Swath Data Fields

### These fields appear for every footprint of every scanline in the granule (GeoTrack * GeoXTrack times)

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| **Geolocation** | | | |
| satzen | 32-bit floating-point | None | Spacecraft zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| satazi | 32-bit floating-point | None | Spacecraft azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| solzen | 32-bit floating-point | None | Solar zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| solazi | 32-bit floating-point | None | Solar azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| sun_glint_distance | 16-bit integer | None | Distance (km) from footprint center to location of the sun glint (-9999 for unknown, 30000 for no glint visible because spacecraft is in Earth's shadow) |
| **Surface ancillary information from geolocation** | | | |
| topog | 32-bit | None | Mean topography in meters |

| | | | |
|---|---|---|---|
| | floating-point | | above reference ellipsoid |
| topog_err | 32-bit floating-point | None | Error estimate for topog |
| landFrac | 32-bit floating-point | None | Fraction of spot that is land (0.0 ... 1.0) |
| landFrac_err | 32-bit floating-point | None | Error estimate for landFrac |
| latAIRS | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Geodetic center latitude of AIRS spots in degrees North (-90.0 ... 90.0) |
| lonAIRS | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Geodetic center longitude of AIRS spots in degrees East (-180.0 ... 180.0) |
| PSurfStd | 32-bit floating-point | None | Surface pressure first guess in hPa, interpolated from forecast |
| PSurfStd_QC | 16-bit unsigned integer | None | Quality flag for surface pressure guess input.;<br>0: Highest Quality -- from timely forecast;<br>1: Good Quality -- from climatology;<br>2: Do Not Use |
| nSurfSup | 32-bit integer | None | Index of last profile pressure layer used in retrieval. (90 ... 100) |
| nSurfStd | 32-bit integer | None | Index in pressStd array of first pressure level above mean surface (1 ... 15) |
| **Dust, SO2, and cloud phase flags from radiances** | | | |
| dust_flag | 16-bit integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Flag telling whether dust was detected in this scene;<br>1: Dust detected;<br>0: Dust not detected;<br>-1: Dust test not valid because of land;<br>-2: Dust test not valid because of high latitude;<br>-3: Dust test not valid because of suspected cloud;<br>-4: Dust test not valid because of bad input data |
| dust_score | 16-bit integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Dust score. Each bit results from a different test comparing radiances. Higher scores indicate more certainty of dust present. |

| | | | |
|---|---|---|---|
| | | | Dust probable when score is over 380. Not valid when dust_flag is negative. |
| BT_diff_SO2 | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Brightness temperature difference Tb(1361.44 cm-1) - Tb(1433.06 cm-1) used as an indicator of SO2 release from volcanoes. Values under -6 K have likely volcanic SO2. (Kelvins) |
| BT_diff_SO2_QC | 16-bit unsigned integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Quality Control for BT_diff_SO2.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| cloud_phase_3x3 | 16-bit integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Flag telling whether clouds are ice or liquid water;<br>-9999: No cloud phase retrieval was possible;<br>-2: Liquid water (high confidence);<br>-1: Liquid water (low confidence);<br>0: Unknown;<br>1: Ice (low confidence);<br>2: Ice (higher confidence);<br>3: Ice (very high confidence);<br>4: Ice (very high confidence) |
| cloud_phase_bits | 16-bit integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Internal bit field of individual tests used in cloud phase determination;<br>Bit 15: (MSB, 0x8000, value 32768) unused;<br>Bit 14: (0x4000, value 16384) unused;<br>Bit 13: (0x2000, value 8192) unused;<br>Bit 12: (0x1000, value 4096) unused;<br>Bit 11: (0x0800, value 2048) unused;<br>Bit 10: (0x0400, value 1024) unused;<br>Bit 9: (0x0200, value 512) Warm test;<br>Bit 8: (0x0100, value 256) Liquid water test #2;<br>Bit 7: (0x0080, value 128) Liquid water test #1;<br>Bit 5: (0x0040, value 64) Ice test #4;<br>Bit 4: (0x0020, value 32) Ice test #3;<br>Bit 3: (0x0010, value 16) Ice |

| | | | |
|---|---|---|---|
| | | | test #2;<br>Bit 2: (0x0008, value 8) Cold cloud test (ice test #1);<br>Bit 2: (0x0004, value 4) Cloud fraction test;<br>Bit 1: (0x0002, value 2) Desert test;<br>Bit 0: (LSB, 0x0001, value 1) One or more tests could not be performed |
| **Quality Indicator Pressure Boundaries** | | | |
| PBest | 32-bit floating-point | None | Maximum value of pressure for which temperature is Quality = 0 (hPa) |
| PGood | 32-bit floating-point | None | Maximum value of pressure for which temperature is Quality = 0 or 1 (hPa) |
| nBestSup | 16-bit integer | None | Support level index of highest pressure (i.e. lowest altitude)for which Quality = 0. A value of 0 indicates that no part of the profile passes the test. (0 ... 100) |
| nGoodSup | 16-bit integer | None | Support level index of highest pressure (i.e. lowest altitude)for which Quality = 0 or 1. A value of 0 indicates that no part of the profile passes the test. (0 ... 100) |
| nBestStd | 16-bit integer | None | Standard level index of highest pressure (i.e. lowest altitude)for which Quality = 0. A value of 29 indicates that no part of the profile passes the test. (1 ... 29) |
| nGoodStd | 16-bit integer | None | Standard level index of highest pressure (i.e. lowest altitude)for which Quality = 0 or 1. A value of 29 indicates that no part of the profile passes the test. (1 ... 29) |
| **Surface Property Retrievals** | | | |
| TSurfStd | 32-bit floating-point | None | Surface skin temperature in Kelvins |
| TSurfStd_QC | 16-bit unsigned integer | None | Quality flag for TSurfStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| TSurfStdErr | 32-bit floating- | None | Error estimate for TSurfStd |

| | | | |
|---|---|---|---|
| | point | | |
| numHingeSurf | 16-bit integer | None | Number of IR hinge points for surface emissivity and reflectivity |
| freqEmis | 32-bit floating-point | HingeSurf (= 100) | Frequencies for surface emissivity and reflectivity in cm-1 (in order of increasing frequency. Only first numHingeSurf elements are valid) |
| emisIRStd | 32-bit floating-point | HingeSurf (= 100) | Spectral IR Surface Emissivities (in order of increasing frequency. Only first numHingeSurf elements are valid) |
| emisIRStd_QC | 16-bit unsigned integer | HingeSurf (= 100) | Quality Control for emisIRStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| emisIRStdErr | 32-bit floating-point | HingeSurf (= 100) | Error estimate for emisIRStd |
| Effective_Solar_Reflectance | 32-bit floating-point | HingeSurf (= 100) | Effective spectral IR bidirectional surface solar reflectance, including cloud shadow effects (in order of increasing frequency. Only first numHingeSurf elements are valid) |
| Effective_Solar_Reflectance_QC | 16-bit unsigned integer | HingeSurf (= 100) | Quality Control for Effective_Solar_Reflectance.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| **Air Temperature Retrievals** | | | |
| TAirSup | 32-bit floating-point | XtraPressureLev (= 100) | Atmospheric Temperature at XtraPressLev in Kelvins. Value at 1-based index of nSurfSup may be an unphysical extrapolated value for a pressure level below the surface. Use TSurfAir for the surface air temperature. |
| TAirSup_QC | 16-bit unsigned integer | XtraPressureLev (= 100) | Quality Control for TAirSup.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| TAirSupErr | 32-bit | XtraPressureLev (= | Error estimate for TAirSup |

| | | | |
|---|---|---|---|
| | floating-point | 100) | (K) |
| TSurfAir | 32-bit floating-point | None | Surface air temperature in Kelvins |
| TSurfAir_QC | 16-bit unsigned integer | None | Quality Control for TSurfAir.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| TSurfAirErr | 32-bit floating-point | None | Error estimate for TSurfAir |
| num_Temp_Func | 16-bit integer | None | Number of valid entries in each dimension of Temp_ave_kern. |
| Temp_ave_kern | 32-bit floating-point | TempFunc (= 23) * TempFunc (= 23) | Averaging kernel for temperature retrieval. |
| Temp_verticality | 32-bit floating-point | TempFunc (= 23) | Sum of the rows of Temp_ave_kern. |
| Temp_dof | 32-bit floating-point | None | Measure of the amount of information in temperature profile retrieval (deg of freedom). |
| **Water Vapor Saturation Quantities Derived from Temperature** | | | |
| H2OMMRSatLevSup | 32-bit floating-point | XtraPressureLev (= 100) | Level Water vapor saturation mass mixing ratio (gm / kg dry air) over equilibrium phase (set to -9999. when saturation pressure exceeds 1% of ambient pressure.) |
| H2OMMRSatLevSup_QC | 16-bit unsigned integer | XtraPressureLev (= 100) | Quality Control for H2OMMRSatLevSup.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| H2OMMRSatSurf | 32-bit floating-point | None | Water Vapor saturation Mass Mixing Ratio at the surface (gm / kg dry air) over equilibrium phase |
| H2OMMRSatSurf_QC | 16-bit unsigned integer | None | Quality Control for H2OMMRSatSurf.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| H2OMMRSatLevSup_liquid | 32-bit floating-point | XtraPressureLev (= 100) | Level Water vapor saturation mass mixing ratio (gm / kg dry air) over liquid phase (set to -9999. when saturation |

| | | | |
|---|---|---|---|
| | | | pressure exceeds 1% of ambient pressure.) |
| H2OMMRSatLevSup_liquid_QC | 16-bit unsigned integer | XtraPressureLev (= 100) | Quality Control for H2OMMRSatLevSup_liquid.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| H2OMMRSatSurf_liquid | 32-bit floating-point | None | Water Vapor saturation Mass Mixing Ratio at the surface (gm / kg dry air) over liquid phase |
| H2OMMRSatSurf_liquid_QC | 16-bit unsigned integer | None | Quality Control for H2OMMRSatSurf_liquid.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| **Tropopause Derived from Temperature** | | | |
| PTropopause | 32-bit floating-point | None | Tropopause height (hPa) |
| PTropopause_QC | 16-bit unsigned integer | None | Quality Control for PTropopause.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| T_Tropopause | 32-bit floating-point | None | Tropopause temperature (K) |
| T_Tropopause_QC | 16-bit unsigned integer | None | Quality Control for T_Tropopause.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| **Water Vapor Retrievals** | | | |
| totH2OStd | 32-bit floating-point | None | Total precipitable water vapor (kg / m**2) |
| totH2OStd_QC | 16-bit unsigned integer | None | Quality Control for totH2OStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| totH2OStdErr | 32-bit floating-point | None | Error estimate for totH2OStd |
| H2OCDSup | 32-bit floating-point | XtraPressureLay (= 100) | Layer column water vapor (molecules / cm**2) |
| H2OCDSup_QC | 16-bit unsigne | XtraPressureLay (= 100) | Quality Control for H2OCDSup.; |

| | | | |
|---|---|---|---|
| | d integer | | 0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| H2OCDSupErr | 32-bit floating-point | XtraPressureLay (= 100) | Error estimate for H2OCDSup |
| H2OMMRLevSup | 32-bit floating-point | XtraPressureLev (= 100) | Water Vapor Mass Mixing Ratio (gm / kg dry air) |
| H2OMMRLevSup_QC | 16-bit unsigned integer | XtraPressureLev (= 100) | Quality Control for H2OMMRLevSup.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| H2OMMRLevSupErr | 32-bit floating-point | XtraPressureLev (= 100) | Error estimate for H2OMMRLevSup |
| H2OMMRSurf | 32-bit floating-point | None | Water Vapor Mass Mixing Ratio at the surface (gm / kg dry air) |
| H2OMMRSurf_QC | 16-bit unsigned integer | None | Quality Control for H2OMMRSurf.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| H2OMMRSurfErr | 32-bit floating-point | None | Error estimate for H2OMMRSurf |
| num_H2O_Func | 16-bit integer | None | Number of valid entries in each dimension of H2O_ave_kern. |
| H2O_eff_press | 32-bit floating-point | H2OFunc (= 11) | H20 effective pressure for the center of each trapezoid |
| H2O_VMR_eff | 32-bit floating-point | H2OFunc (= 11) | Effective H2O volume mixing ratio for each trapezoid. |
| H2O_VMR_eff_QC | 16-bit unsigned integer | H2OFunc (= 11) | Quality Control for H2O_VMR_eff.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| H2O_VMR_eff_err | 32-bit floating-point | H2OFunc (= 11) | Error estimate for H2O_VMR_eff |
| H2O_verticality | 32-bit floating-point | H2OFunc (= 11) | Sum of the rows of H2O_ave_kern. |
| H2O_dof | 32-bit floating- | None | Measure of the amount of information in H2O retrieval |

| | | | |
|---|---|---|---|
| | point | | (deg of freedom). |
| H2O_ave_kern | 32-bit floating-point | H2OFunc (= 11) * H2OFunc (= 11) | Averaging kernel for water vapor retrieval. |
| **Relative Humidity, Boundary Layer Top, and Geopotential Height Derived from Temperature and Water Vapor** | | | |
| RelHum | 32-bit floating-point | H2OPressureLev (= 15) | Relative humidity over equilibrium phase (%) |
| RelHum_QC | 16-bit unsigned integer | H2OPressureLev (= 15) | Quality control for RelHum.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| RelHumSurf | 32-bit floating-point | None | Relative humidity at the surface over equilibrium phase (%) |
| RelHumSurf_QC | 16-bit unsigned integer | None | Quality Control for RelHumSurf.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| RelHum_liquid | 32-bit floating-point | H2OPressureLev (= 15) | Relative humidity over liquid phase (%) |
| RelHum_liquid_QC | 16-bit unsigned integer | H2OPressureLev (= 15) | Quality control for RelHum_liquid.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| RelHumSurf_liquid | 32-bit floating-point | None | Relative humidity at the surface over liquid phase (%) |
| RelHumSurf_liquid_QC | 16-bit unsigned integer | None | Quality Control for RelHumSurf_liquid.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| bndry_lyr_top | 32-bit floating-point | None | Pressure at top of boundary layer (hPa) |
| bndry_lyr_top_QC | 16-bit unsigned integer | None | Quality Control for bndry_lyr_top.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| GP_Tropopause | 32-bit floating-point | None | Geopotential height at tropopause (m above mean sea level) |
| GP_Tropopause_QC | 16-bit unsigne | None | Quality Control for GP_Tropopause.; |

| | | | |
|---|---|---|---|
| | d integer | | 0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| GP_HeightSup | 32-bit floating-point | XtraPressureLev (= 100) | Geopotential Heights (m above mean sea level) |
| GP_HeightSup_QC | 16-bit unsigned integer | XtraPressureLev (= 100) | Quality Control for GP_HeightSup.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| GP_Surface | 32-bit floating-point | None | Geopotential Height of surface (m above mean sea level) |
| GP_Surface_QC | 16-bit unsigned integer | None | Quality Control for GP_Surface.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| **Longwave IR Cloud Formation Retrievals on 3 by 3 AIRS Fields of View** | | | |
| CldFrcTot | 32-bit floating-point | None | Total cloud fraction over all cloud layers and all 9 spots (0.0 ... 1.0) assuming unit cloud top emissivity. |
| CldFrcTot_QC | 16-bit unsigned integer | None | Quality Control for CldFrcTot.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| CldFrcStd | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) * Cloud (= 2) | Cloud fraction (0.0 ... 1.0) assuming unit cloud top emissivity (in order of increasing pressure. Only first nCld elements are valid) Caution: For CldFrcStd = 1, only the average cloud fraction over the nine spots is reported (duplicated nine times) for each level. |
| CldFrcStd_QC | 16-bit unsigned integer | AIRSTrack (= 3) * AIRSXTrack (= 3) * Cloud (= 2) | Quality Control for CldFrcStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| CldFrcStdErr | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) * Cloud (= 2) | Error estimate for CldFrcStd |
| PCldTop | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) * Cloud (= 2) | Cloud top pressure in hPa. (in order of increasing pressure. Only first nCld elements are valid) |

| | | | |
|---|---|---|---|
| PCldTop_QC | 16-bit unsigned integer | AIRSTrack (= 3) * AIRSXTrack (= 3) * Cloud (= 2) | Quality Control for PCldTop.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| PCldTopErr | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) * Cloud (= 2) | Error estimate for PCldTop. |
| TCldTop | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) * Cloud (= 2) | Cloud top temperature in Kelvins (in order of increasing pressure. Only first nCld elements are valid) |
| TCldTop_QC | 16-bit unsigned integer | AIRSTrack (= 3) * AIRSXTrack (= 3) * Cloud (= 2) | Quality Control for TCldTop.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| TCldTopErr | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) * Cloud (= 2) | Error estimate for TCldTop. |
| nCld | 32-bit integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Number of cloud layers in each of the 9 spots |
| **Longwave IR Cloud Formation Retrievals on Single AMSU Fields of View** | | | |
| PCldTopStd | 32-bit floating-point | Cloud (= 2) | Cloud top pressure in hPa assuming the same two cloud formations over all 9 spots.;<br>DEPRECATED. Newer PCldTop is a more finely resolved version. |
| PCldTopStd_QC | 16-bit unsigned integer | Cloud (= 2) | Quality Control for PCldTopStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| PCldTopStdErr | 32-bit floating-point | Cloud (= 2) | Error estimate for PCldTopStd |
| TCldTopStd | 32-bit floating-point | Cloud (= 2) | Cloud top temperature in Kelvins (in order of increasing pressure. Only first numCloud elements are valid) assuming the same two cloud formations over all 9 spots.;<br>DEPRECATED. Newer TCldTop is a more finely resolved version. |
| TCldTopStd_QC | 16-bit unsigned integer | Cloud (= 2) | Quality Control for TCldTopStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |

| | | | |
|---|---|---|---|
| TCldTopStdErr | 32-bit floating-point | Cloud (= 2) | Error estimate for TCldTopStd |
| numCloud | 32-bit integer | None | Number of cloud layers (max over the 9 spots). Deprecated. Use only with deprecated fields PCldTopStd and TCldTopStd. Otherwise use nCld. |
| **Cloud Spectral Properties assumed in Longwave IR Cloud Formation Retrievals** | | | |
| numHingeCloud | 16-bit integer | None | Number of hinge points for cloud emissivity and reflectivity |
| cldFreq | 32-bit floating-point | Cloud (= 2) * HingeCloud (= 7) | Frequencies for cloud emissivity and reflectivity (in order of increasing pressure. Only first numCloud elements are valid) (in order of increasing frequency. Only first numHingeCloud elements are valid) |
| CldEmis | 32-bit floating-point | Cloud (= 2) * HingeCloud (= 7) | Ratio of cloud IR emissivity to that at 930 cm-1 (in order of increasing frequency. Only first numHingeCloud elements are valid) |
| CldEmis_QC | 16-bit unsigned integer | Cloud (= 2) * HingeCloud (= 7) | Quality Control for CldEmis.; 0: Highest Quality; 1: Good Quality; 2: Do Not Use; Set to 1 to show the value is assumed, not retrieved |
| CldEmisErr | 32-bit floating-point | Cloud (= 2) * HingeCloud (= 7) | Error estimate for CldEmis |
| CldRho | 32-bit floating-point | Cloud (= 2) * HingeCloud (= 7) | Future Cloud IR reflectivity -- DO NOT USE |
| CldRho_QC | 16-bit unsigned integer | Cloud (= 2) * HingeCloud (= 7) | Quality Control for CldRho.; 0: Highest Quality; 1: Good Quality; 2: Do Not Use; Set to 1 to show the value is assumed, not retrieved |
| CldRhoErr | 32-bit floating-point | Cloud (= 2) * HingeCloud (= 7) | Error estimate for CldRho |
| **Cirrus Cloud Optical Properties Retrievals** | | | |
| ice_cld_opt_dpth | 32-bit floating- | AIRSTrack (= 3) * AIRSXTrack (= 3) | Ice cloud optical depth |

| | | | |
|---|---|---|---|
| | point | | |
| ice_cld_opt_dpth_QC | 16-bit unsigned integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Quality control for ice_cld_opt_dpth.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| ice_cld_eff_diam | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Ice cloud effective diameter (microns) |
| ice_cld_eff_diam_QC | 16-bit unsigned integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Quality control for ice_cld_eff_diam.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| ice_cld_temp_eff | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Ice cloud effective cloud top temperature (K) |
| ice_cld_temp_eff_QC | 16-bit unsigned integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Quality control for ice_cld_temp_eff.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| ice_cld_fit_reduced_chisq | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Normalized chi-square of the obs-calc radiance residual in the ice cloud optical properties calculation |
| ice_cld_opt_dpth_ave_kern | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Scalar value of averaging kernel for ice cloud optical depth |
| ice_cld_eff_diam_ave_kern | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Scalar value of averaging kernel for ice cloud effective diameter |
| ice_cld_temp_eff_ave_kern | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Scalar value of averaging kernel for ice cloud effective cloud top temperature |
| ice_cld_opt_dpth_err | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Error estimate for ice cloud optical depth |
| ice_cld_eff_diam_err | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Error estimate for ice cloud effective diameter |
| ice_cld_temp_eff_err | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Error estimate for ice cloud effective cloud top temperature (K) |
| log_ice_cld_opt_dpth_prior_var | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | A priori variance for the logarithm of ice cloud optical depth |
| log_ice_cld_eff_diam_prior_var | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | A priori variance for the logarithm of ice cloud effective diameter |

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| ice_cld_temp_eff_prior_var | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | A priori variance for ice cloud effective cloud top temperature (K) |
| ice_cld_opt_dpth_first_guess | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | First guess for ice cloud optical depth |
| ice_cld_eff_diam_first_guess | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | First guess for ice cloud effective diameter |
| ice_cld_temp_eff_first_guess | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | First guess for ice cloud effective cloud top temperature (K) |
| **Ozone Retrievals** | | | |
| totO3Std | 32-bit floating-point | None | Total ozone burden (Dobson units) |
| totO3Std_QC | 16-bit unsigned integer | None | Quality Control for totO3Std.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| totO3StdErr | 32-bit floating-point | None | Error estimate for totO3Std |
| O3CDSup | 32-bit floating-point | XtraPressureLay (= 100) | Layer column ozone in molecules per cm**2 |
| O3CDSup_QC | 16-bit unsigned integer | XtraPressureLay (= 100) | Quality Control for O3CDSup.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| O3CDSupErr | 32-bit floating-point | XtraPressureLay (= 100) | Error estimate for O3CDSupErr |
| O3VMRLevSup | 32-bit floating-point | XtraPressureLev (= 100) | Ozone Volume Mixing Ratio on support levels (ppv) |
| O3VMRLevSup_QC | 16-bit unsigned integer | XtraPressureLev (= 100) | Quality Control for O3VMRLevSup.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| O3VMRLevSupErr | 32-bit floating-point | XtraPressureLev (= 100) | Error estimate for O3VMRLevSup |
| O3VMRSurf | 32-bit floating-point | None | Ozone Volume Mixing Ratio at the surface (ppv) |
| O3VMRSurf_QC | 16-bit | None | Quality Control for |

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| | unsigned integer | | O3VMRSurf.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| O3VMRSurfErr | 32-bit floating-point | None | Error estimate for O3VMRSurf |
| num_O3_Func | 16-bit integer | None | Number of valid entries in each dimension of O3_ave_kern. |
| O3_eff_press | 32-bit floating-point | O3Func (= 9) | O3 effective pressure for the center of each trapezoid |
| O3_VMR_eff | 32-bit floating-point | O3Func (= 9) | Effective O3 volume mixing ratio for each trapezoid. |
| O3_VMR_eff_QC | 16-bit unsigned integer | O3Func (= 9) | Quality Control for O3_VMR_eff.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| O3_VMR_eff_err | 32-bit floating-point | O3Func (= 9) | Error estimate for O3_VMR_eff |
| O3_verticality | 32-bit floating-point | O3Func (= 9) | Sum of the rows of O3_ave_kern. |
| O3_dof | 32-bit floating-point | None | Measure of the amount of information in O3 retrieval (deg of freedom). |
| O3_ave_kern | 32-bit floating-point | O3Func (= 9) * O3Func (= 9) | Averaging kernel for ozone retrieval. |
| | **Carbon Monoxide Retrievals** | | |
| CO_total_column | 32-bit floating-point | None | Retrieved total column CO (molecules/cm2). |
| CO_total_column_QC | 16-bit unsigned integer | None | Quality Control for CO_total_column.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| COCDSup | 32-bit floating-point | XtraPressureLay (= 100) | Layer column carbon monoxide in molecules per cm**2 (climatology when bad_co is not 0) |
| COCDSup_QC | 16-bit unsigned integer | XtraPressureLay (= 100) | Quality Control for COCDSup.;<br>0: Highest Quality;<br>1: Good Quality; |

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| | | | 2: Do Not Use |
| COCDSupErr | 32-bit floating-point | XtraPressureLay (= 100) | Error estimate for COCDSup |
| COVMRLevSup | 32-bit floating-point | XtraPressureLev (= 100) | CO Volume Mixing Ratio at support levels (ppv) |
| COVMRLevSup_QC | 16-bit unsigned integer | XtraPressureLev (= 100) | Quality Control for COVMRLevSup.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| COVMRLevSupErr | 32-bit floating-point | XtraPressureLev (= 100) | Error estimate for COVMRLevSup |
| COVMRSurf | 32-bit floating-point | None | CO Volume Mixing Ratio at the surface (ppv) |
| COVMRSurf_QC | 16-bit unsigned integer | None | Quality Control for COVMRSurf.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| COVMRSurfErr | 32-bit floating-point | None | Error estimate for COVMRSurf |
| num_CO_Func | 16-bit integer | None | Number of valid entries in each dimension of CO_ave_kern. |
| CO_eff_press | 32-bit floating-point | COFunc (= 9) | CO effective pressure for the center of each trapezoid |
| CO_VMR_eff | 32-bit floating-point | COFunc (= 9) | Effective CO volume mixing ratio for each trapezoid. |
| CO_VMR_eff_QC | 16-bit unsigned integer | COFunc (= 9) | Quality Control for CO_VMR_eff.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| CO_VMR_eff_err | 32-bit floating-point | COFunc (= 9) | Error estimate for CO_VMR_eff |
| CO_verticality | 32-bit floating-point | COFunc (= 9) | Sum of the rows of CO_ave_kern. |
| CO_dof | 32-bit floating-point | None | Measure of the amount of information in CO retrieval (deg of freedom). |

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| CO_ave_kern | 32-bit floating-point | COFunc (= 9) * COFunc (= 9) | Averaging kernel for carbon monoxide retrieval. |
| **Methane Retrievals** | | | |
| CH4_total_column | 32-bit floating-point | None | Retrieved total column CH4 (molecules/cm2). |
| CH4_total_column_QC | 16-bit unsigned integer | None | Quality Control for CH4_total_column.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| CH4CDSup | 32-bit floating-point | XtraPressureLay (= 100) | Layer column methane (in molecules per cm**2) |
| CH4CDSup_QC | 16-bit unsigned integer | XtraPressureLay (= 100) | Quality Control for CH4CDSup.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| CH4CDSupErr | 32-bit floating-point | XtraPressureLay (= 100) | Error estimate for CH4CDSup |
| CH4VMRLevSup | 32-bit floating-point | XtraPressureLev (= 100) | CH4 Volume Mixing Ratio at support levels (ppv) |
| CH4VMRLevSup_QC | 16-bit unsigned integer | XtraPressureLev (= 100) | Quality Control for CH4VMRLevSup.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| CH4VMRLevSupErr | 32-bit floating-point | XtraPressureLev (= 100) | Error estimate for CH4VMRLevSup |
| CH4VMRSurf | 32-bit floating-point | None | CH4 Volume Mixing Ratio at the surface (ppv) |
| CH4VMRSurf_QC | 16-bit unsigned integer | None | Quality Control for CH4VMRSurf.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| CH4VMRSurfErr | 32-bit floating-point | None | Error estimate for CH4VMRSurf |
| num_CH4_Func | 16-bit integer | None | Number of valid entries in each dimension of CH4_ave_kern. |
| CH4_eff_press_10func | 32-bit floating- | CH4Func (= 10) | CH4 effective pressure for the center of each trapezoid |

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| | point | | |
| CH4_VMR_eff_10func | 32-bit floating-point | CH4Func (= 10) | Effective CH4 volume mixing ratio for each trapezoid. |
| CH4_VMR_eff_10func_QC | 16-bit unsigned integer | CH4Func (= 10) | Quality Control for CH4_VMR_eff_10func.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| CH4_VMR_eff_10func_err | 32-bit floating-point | CH4Func (= 10) | Error estimate for CH4_VMR_eff |
| CH4_verticality_10func | 32-bit floating-point | CH4Func (= 10) | Sum of the rows of CH4_ave_kern. |
| CH4_dof | 32-bit floating-point | None | Measure of the amount of information in CH4 retrieval (deg of freedom). |
| CH4_ave_kern_10func | 32-bit floating-point | CH4Func (= 10) * CH4Func (= 10) | Averaging kernel for methane retrieval. |
| **Outgoing Longwave Radiation Retrievals** | | | |
| olr | 32-bit floating-point | None | Outgoing Longwave Radiation Flux integrated over 2 to 2800 cm**-1 (per 45 km AMSU-A FOV) (Watts/m**2) |
| olr_QC | 16-bit unsigned integer | None | Quality Control for olr.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| spectralolr | 32-bit floating-point | OLRBand (= 16) | Outgoing Longwave Radiation Flux integrated over 16 frequency bands (per 45 km AMSU-A FOV) (Watts/m**2) |
| spectralolr_QC | 16-bit unsigned integer | OLRBand (= 16) | Quality Control for spectralolr.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| olr3x3 | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Outgoing Longwave Radiation Flux integrated over 2 to 2800 cm**-1 (per 15 km AIRS FOV) (Watts/m**2) |
| olr3x3_QC | 16-bit unsigned integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Quality Control for olr3x3.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |

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| olr_err | 32-bit floating-point | None | Error estimate for olr (Watts/m**2) |
| clrolr | 32-bit floating-point | None | Clear-sky Outgoing Longwave Radiation Flux integrated over 2 to 2800 cm**-1 (per 45 km AMSU-A FOV) (Watts/m**2) |
| clrolr_QC | 16-bit unsigned integer | None | Quality Control for clrolr.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| clrolr_err | 32-bit floating-point | None | Error estimate for clrolr (Watts/m**2) |
| spectralclrolr | 32-bit floating-point | OLRBand (= 16) | Clear-sky Outgoing Longwave Radiation Flux integrated over 16 frequency bands (per 45 km AMSU-A FOV) (Watts/m**2) |
| spectralclrolr_QC | 16-bit unsigned integer | OLRBand (= 16) | Quality Control for spectralclrolr.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| **Geolocation QA** | | | |
| ftptgeoqa | 32-bit unsigned integer | None | See Appendix D |
| zengeoqa | 16-bit unsigned integer | None | See Appendix D |
| demgeoqa | 16-bit unsigned integer | None | See Appendix D |
| **Miscellaneous** | | | |
| all_spots_avg | 8-bit integer | None | 1: the cloud clearing step judged the scene to be clear enough that it averaged all spots' radiances;<br>0: cloud clearing was applied to the radiances;<br>-1/255: cloud clearing not attempted |
| retrieval_type | 8-bit integer | None | Deprecated -- use Xxx_QC flags. Retrieval type:;<br>0 for full retrieval;<br>10 for MW + final succeeded, initial retrieval failed;<br>20 for MW + initial succeeded, final failed; |

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| | | | 30 for only MW stage succeeded, initial + final retrieval failed;<br>40 for MW + initial succeeded, final cloud-clearing failed;<br>50 for only MW stage succeeded, initial + final cloud-clearing failed;<br>100 for no retrieval; |
| SurfClass | 8-bit integer | None | Surface class used in physical retrieval, from microwave (MW) and/or infrared (IR). Identical to MWSurfClass when MW is used:;<br>0 for coastline (Liquid water covers 50-99% of area);<br>1 for land (Liquid water covers < 50% of area);<br>2 for ocean (Liquid water covers > 99% of area);<br>3 for sea ice (Indicates high MW emissivity when MW information is used);<br>4 for sea ice (Indicates low MW emissivity. This value is only produced when MW information is used.);<br>5 for snow (Indicates higher-frequency MW scattering when MW information is used);<br>6 for glacier/snow (Indicates very low-frequency MW scattering. This value is only produced when MW information is used.);<br>7 for snow (Indicates lower-frequency MW scattering. This value is only produced when MW information is used.);<br>-1 for unknown |
| IR_Precip_Est | 32-bit floating-point | None | Regression-based estimate of daily precipitation based on clouds and relative humidity from Level 2 IR/MW retrieval. Analogous to and forms a continuous record when used with TOVS precipitation index. (per 45 km AMSU-A FOV) (mm/day) |
| IR_Precip_Est_QC | 16-bit | None | Quality Control for |

| | | | |
|---|---|---|---|
| | unsigned integer | | IR_Precip_Est.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| IR_Precip_Est3x3 | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Regression-based estimate of daily precipitation based on clouds and relative humidity from Level 2 IR/MW retrieval. Analogous to and forms a continuous record when used with TOVS precipitation index. (per 15 km AIRS FOV) (mm/day) |
| IR_Precip_Est3x3_QC | 16-bit unsigned integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Quality Control for IR_Precip_Est3x3.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| IR_Precip_Est_Err | 32-bit floating-point | None | Error estimate for IR_Precip_Est |
| **Microwave Dependent** | | | |
| TAirMWOnly | 32-bit floating-point | XtraPressureLev (= 100) | Air temperature in Kelvins from startup microwave-only retrieval. |
| TAirMWOnly_QC | 16-bit unsigned integer | XtraPressureLev (= 100) | Quality Control for TAirMWOnly.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| TAirMWOnlyErr | 32-bit floating-point | StdPressureLev (= 28) | Error estimate for TAirMWOnly (Note that error estimate only made at StdPressureLev points even though TAirMWOnly is estimated at XtraPressureLev points) |
| MWSurfClass | 8-bit integer | None | Surface class from microwave (MW) information:;<br>0 for coastline (Liquid water covers 50-99% of area);<br>1 for land (Liquid water covers < 50% of area);<br>2 for ocean (Liquid water covers > 99% of area);<br>3 for sea ice (High MW emissivity);<br>4 for sea ice (Low MW emissivity);<br>5 for snow (Higher-frequency MW scattering); |

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| | | | 6 for glacier/snow (Very low-frequency MW scattering);<br>7 for snow (Lower-frequency MW scattering);<br>-1 for unknown (not attempted) |
| sfcTbMWStd | 32-bit floating-point | MWHingeSurf (= 7) | Microwave surface brightness (Kelvins) (Emitted radiance only, reflected radiance not included. Product of MW only algorithm) |
| sfcTbMWStd_QC | 16-bit unsigned integer | MWHingeSurf (= 7) | Quality Control for sfcTbMWStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| EmisMWStd | 32-bit floating-point | MWHingeSurf (= 7) | Spectral MW emissivity at the 7 MW frequencies listed for dimension MWHingeSurf (Product of MW only algorithm) |
| EmisMWStd_QC | 16-bit unsigned integer | MWHingeSurf (= 7) | Quality Control for EmisMWStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| EmisMWStdErr | 32-bit floating-point | MWHingeSurf (= 7) | Error estimate for EmisMWStd |
| Emis50GHz | 32-bit floating-point | None | Microwave emissivity at 50.3 GHz (This is from combined IR/MW retrieval. The shape of MW spectral emissivity stays the same as MW only algorithm.) |
| Emis50GHz_QC | 16-bit unsigned integer | None | Quality Control for Emis50GHz.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| totH2OMWOnlyStd | 32-bit floating-point | None | Total precipitable water vapor from MW-only retrieval (no IR information used) (kg / m**2) |
| totH2OMWOnlyStd_QC | 16-bit unsigned integer | None | Quality Control for totH2OMWOnlyStd.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| H2OCDMWOnly | 32-bit | XtraPressureLay (= | Layer column water vapor |

| | | | |
|---|---|---|---|
| | floating-point | 100) | from microwave-only retrieval. (molecules / cm**2) |
| H2OCDMWOnly_QC | 16-bit unsigned integer | XtraPressureLay (= 100) | Quality Control for H2OCDMWOnly.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| totCldH2OStd | 32-bit floating-point | None | Total cloud liquid water in kg/m**2 |
| totCldH2OStd_QC | 16-bit unsigned integer | None | Quality Control for totCldH2OStd;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| totCldH2OStdErr | 32-bit floating-point | None | Error estimate for totCldH2OStd |
| satzen_amsu | 32-bit floating-point | None | Satellite zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) (AMSU-A FOV center) |
| satazi_amsu | 32-bit floating-point | None | Spacecraft azimuth angle (-180.0 ... 180.0) degrees E of N GEO (AMSU-A FOV center) |
| **HSB Dependent** | | | |
| PrecipAA4_50km | 8-bit unsigned integer | None | Relative interference (0-2) of precipitation on AMSU-A channel 4 (-1/255 for unknown) |
| PrecipAA5_50km | 8-bit unsigned integer | None | Relative interference (0-2) of precipitation on AMSU-A channel 5 (-1/255 for unknown) |
| PrecipAA6_50km | 8-bit unsigned integer | None | Relative interference (0-2) of precipitation on AMSU-A channel 6 (-1/255 for unknown) |
| PrecipAA7_50km | 8-bit unsigned integer | None | Relative interference (0-2, 3=indeterminate) of precipitation on AMSU-A channel 7 (-1/255 for unknown) |
| PrecipAA8_50km | 8-bit unsigne | None | Relative interference (0-2) of precipitation on AMSU-A |

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|---|---|---|---|
| | d integer | | channel 8 (-1/255 for unknown) |
| PrecipAA9_50km | 8-bit unsigned integer | None | Relative interference (0-2) of precipitation on AMSU-A channel 9 (-1/255 for unknown) |
| PrecipAA4_15km | 8-bit unsigned integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Relative interference (0-2) of precipitation on AMSU-A channel 4 for HSB 15-km spots (-1/255 for unknown) |
| PrecipAA5_15km | 8-bit unsigned integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Relative interference (0-2) of precipitation on AMSU-A channel 5 for HSB 15-km spots (-1/255 for unknown) |
| PrecipAA6_15km | 8-bit unsigned integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Relative interference (0-2) of precipitation on AMSU-A channel 6 for HSB 15-km spots (-1/255 for unknown) |
| PrecipAA7_15km | 8-bit unsigned integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Relative interference (0-2, 3=indeterminate) of precipitation on AMSU-A channel 7 for HSB 15-km spots (-1/255 for unknown) |
| PrecipAA8_15km | 8-bit unsigned integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Relative interference (0-2) of precipitation on AMSU-A channel 8 for HSB 15-km spots (-1/255 for unknown) |
| PrecipAA9_15km | 8-bit unsigned integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Relative interference (0-2) of precipitation on AMSU-A channel 9 for HSB 15-km spots (-1/255 for unknown) |
| AMSU_A_4_Precip_Corr_50km | 32-bit floating-point | None | Correction to AMSU-A channel 4 for precipitation effects (Kelvins) |
| AMSU_A_5_Precip_Corr_50km | 32-bit floating-point | None | Correction to AMSU-A channel 5 for precipitation effects (Kelvins) |
| AMSU_A_6_Precip_Corr_50km | 32-bit floating-point | None | Correction to AMSU-A channel 6 for precipitation effects (Kelvins) |
| AMSU_A_7_Precip_Corr_50km | 32-bit floating-point | None | Correction to AMSU-A channel 7 for precipitation effects (Kelvins) |
| AMSU_A_8_Precip_Corr_50km | 32-bit floating-point | None | Correction to AMSU-A channel 8 for precipitation effects (Kelvins) |
| AMSU_A_9_Precip_Corr_50km | 32-bit floating-point | None | Correction to AMSU-A channel 9 for precipitation effects (Kelvins) |
| AMSU_A_4_Precip_Corr_15km | 32-bit | AIRSTrack (= 3) * | Correction to AMSU-A |

| | | | |
|---|---|---|---|
| | floating-point | AIRSXTrack (= 3) | channel 4 for precipitation effects for HSB 15-km spots (Kelvins) |
| AMSU_A_5_Precip_Corr_15km | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Correction to AMSU-A channel 5 for precipitation effects for HSB 15-km spots (Kelvins) |
| AMSU_A_6_Precip_Corr_15km | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Correction to AMSU-A channel 6 for precipitation effects for HSB 15-km spots (Kelvins) |
| AMSU_A_7_Precip_Corr_15km | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Correction to AMSU-A channel 7 for precipitation effects for HSB 15-km spots (Kelvins) |
| AMSU_A_8_Precip_Corr_15km | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Correction to AMSU-A channel 8 for precipitation effects for HSB 15-km spots (Kelvins) |
| AMSU_A_9_Precip_Corr_15km | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Correction to AMSU-A channel 9 for precipitation effects for HSB 15-km spots (Kelvins) |
| rain_rate_50km | 32-bit floating-point | None | Rain rate (mm/hr) |
| rain_rate_15km | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Rain rate for HSB 15-km spots (mm/hr) |
| lwCDSup | 32-bit floating-point | XtraPressureLay (= 100) | Layer molecular column density (molecules / cm**2) of cloud liquid water |
| lwCDSup_QC | 16-bit unsigned integer | XtraPressureLay (= 100) | Quality Control for lwCDSup.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| lwCDSupErr | 32-bit floating-point | XtraPressureLay (= 100) | Error estimate for lwCDSup |
| cIWSup | 32-bit integer | XtraPressureLay (= 100) | Cloud Ice/Water flag (liquid = 0 / Ice = 1) |
| satzen_hsb | 32-bit floating-point | None | Satellite zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) (HSB center FOV) |

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| satazi_hsb | 32-bit floating-point | None | Spacecraft azimuth angle (-180.0 ... 180.0) degrees E of N GEO (HSB center FOV) |
| **Forecast Quantities** | | | |
| tsurf_forecast | 32-bit floating-point | None | Predicted surface temperature interpolated from NOAA NCEP GFS forecast (K) |
| Forecast_Wind_U | 32-bit floating-point | None | 10 meter above surface zonal wind (+ toward east) in meters per second, interpolated from NOAA NCEP GFS forecast. |
| Forecast_Wind_V | 32-bit floating-point | None | 10 meter above surface meridional wind (+ toward north) in meters per second, interpolated from NOAA NCEP GFS forecast. |
| **Climatology Quantities** | | | |
| MODIS_emis | 32-bit floating-point | MODISEmisBand (= 6) | First guess climatology emissivity from MODIS averaged over MYD11C3 0.05 degree (~5 km) pixels covering an area roughly corresponding to an AMSU FOV or 3x3 of AIRS FOVs. |
| MODIS_emis_dev | 32-bit floating-point | MODISEmisBand (= 6) | Standard Deviation among the MYD11C3 elements used to determine MODIS_emis |
| MODIS_emis_qct | 16-bit integer | MODISEmisQualLevels (= 4) | Count of MODIS emissivity pixels used in each quality category |
| MODIS_emis_spots | 32-bit floating-point | MODISEmisBand (= 6) * AIRSTrack (= 3) * AIRSXTrack (= 3) | First guess emissivity from MODIS averaged over MYD11C3 0.05 degree (~5 km) pixels covering an area roughly corresponding to an AIRS FOV. |
| MODIS_emis_spots_dev | 32-bit floating-point | MODISEmisBand (= 6) * AIRSTrack (= 3) * AIRSXTrack (= 3) | Standard Deviation among the MYD11C3 elements used to determine MODIS_emis |
| MODIS_emis_10_hinge | 32-bit floating-point | MODISEmis10Hinge (= 10) | First guess emissivity from MODIS (MODIS_emis) expanded to 10 hinge points |
| MODIS_LST | 32-bit floating-point | None | First guess climatology land surface temperature from MODIS averaged over MYD11C3 0.05 degree (~5 km) pixels covering an area |

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| | | | roughly corresponding to an AMSU FOV or 3x3 of AIRS FOVs. |
| MODIS_LST_dev | 32-bit floating-point | None | Standard Deviation among the MYD11C3 elements used to determine MODIS_LST |
| MODIS_LST_qct | 16-bit integer | MODISLSTQualLevels (= 4) | Count of MODIS land surface temperature pixels used in each quality category |
| MODIS_LST_spots | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | First guess land surface temperature from MODIS averaged over MYD11C3 0.05 degree (~5 km) pixels covering an area roughly corresponding to an AIRS FOV. |
| MODIS_LST_spots_dev | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Standard Deviation among the MYD11C3 elements used to determine MODIS_LST_spots |
| CO2ppmv | 32-bit floating-point | None | Column averaged dry carbon dioxide volumetric mixing ratio (ppmv) |
| CO2ppmv_QC | 16-bit unsigned integer | None | Quality Control for CO2ppmv.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use;<br>Set to 2 because the current value is from a model instead of a retrieved value. |
| CO2ppmvErr | 32-bit floating-point | None | Error estimate for CO2ppmv |
| TSurfClim | 32-bit floating-point | None | Surface temperature guess from climatology in Kelvins |
| TSurfAirClim | 32-bit floating-point | None | Surface air temperature guess from climatology in Kelvins |
| TAirClim | 32-bit floating-point | XtraPressureLev (= 100) | Air temperature guess from climatology in Kelvins |
| H2OCDClim | 32-bit floating-point | XtraPressureLay (= 100) | Layer column water vapor guess from climatology (molecules / cm**2) |
| Tropo_CCI | 32-bit floating-point | None | A Tropospheric Coarse Climate Indicator representing the weighted average of retrieved |

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| | | | temperatures over the lower troposphere (maximum weight near 700 hPa). The weighting is done in such a manner as to make the weighted temperatures roughly correspond to those given by the MSU2R products in the Spencer and Christy temperature data set, as well as in the TOVS Pathfinder Path A data set (K) |
| Tropo_CCI_QC | 16-bit unsigned integer | None | Quality Control for Tropo_CCI.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| Tropo_CCI_Est_Err | 32-bit floating-point | None | Error estimate for Tropo_CCI |
| Strato_CCI | 32-bit floating-point | None | A Stratospheric Coarse Climate Indicator representing the weighted average of retrieved temperatures over the lower stratosphere (maximum weight near 70 hPa). The weighting is done in such a manner as to make the weighted temperatures roughly correspond to those given by the MSU4 products in the Spencer and Christy temperature data set, as well as in the TOVS Pathfinder Path A data set (K) |
| Strato_CCI_QC | 16-bit unsigned integer | None | Quality Control for Strato_CCI.;<br>0: Highest Quality;<br>1: Good Quality;<br>2: Do Not Use |
| Strato_CCI_Est_Err | 32-bit floating-point | None | Error estimate for Strato_CCI |
| **Quality Indicators for internal use in algorithm evaluation** | | | |
| MoonInViewIR | 16-bit integer | None | Flag if moon was in the spaceview for IR calibration. IR calibration will handle this case, but there may be a small degradation in radiance quality. (1: moon in spaceview, 0: moon not in |

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| | | | spaceview, -9999: unknown) |
| pseudo_lapse_rate | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Pseudo lapse rate is BT diff of channels 2109 and 2108 (K). Their frequencies are 2388 and 2387 cm-1, respectively. Low values within +/-45 degrees of equator usually indicate existence of cloud. Use with caution at higher latitudes. |
| TAirSCCNN | 32-bit floating-point | XtraPressureLev (= 100) | Air temperature in Kelvins from SCCNN processing. |
| TAirCldyReg | 32-bit floating-point | XtraPressureLev (= 100) | Air temperature in Kelvins from startup cloudy regression retrieval. (not used in retrieval) |
| H2OCDSCCNN | 32-bit floating-point | XtraPressureLay (= 100) | Layer column water vapor from SCCNN processing. (molecules / cm**2) |
| H2OCDCldyReg | 32-bit floating-point | XtraPressureLay (= 100) | Layer column water vapor from cloudy regression retrieval. (not used in retrieval) (molecules / cm**2) |
| TSurfSCCNN | 32-bit floating-point | None | Surface temperature from SCCNN in Kelvins |
| TSurf1Ret | 32-bit floating-point | None | Surface temperature after regression retrieval in Kelvins (not used in retrieval) |
| TSurfAir1Ret | 32-bit floating-point | None | Surface air temperature after regression retrieval in Kelvins (not used in retrieval) |
| TAir1Ret | 32-bit floating-point | XtraPressureLev (= 100) | Air temperature after regression retrieval in Kelvins (not used in retrieval) |
| H2OCD1Ret | 32-bit floating-point | XtraPressureLay (= 100) | Layer column water vapor after regression retrieval (molecules / cm**2) (not used in retrieval) |
| O3CDInit | 32-bit floating-point | XtraPressureLay (= 100) | preliminary Layer column ozone in molecules per cm**2 from initial regression step (not used in retrieval) |
| numHingeSurfFG | 16-bit integer | None | Number of IR hinge points for first guess surface emissivity |
| freqEmisFG | 32-bit floating-point | HingeSurf (= 100) | Frequencies for first guess surface emissivity in cm-1 (in order of increasing |

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| | | | frequency. Only first numHingeSurfFG elements are valid) |
| emisIRFG | 32-bit floating-point | HingeSurf (= 100) | First guess Spectral IR Surface Emissivities (in order of increasing frequency. Only first numHingeSurfFG elements are valid) |
| emisIRInit | 32-bit floating-point | HingeSurfInit (= 50) | IR Surface Emissivities from initial regression (in order of increasing frequency. Only first numHingeSurfInit elements are valid) (not used in retrieval) |
| rhoIRInit | 32-bit floating-point | HingeSurfInit (= 50) | IR Surface Reflectivities from initial regression (in order of increasing frequency. Only first numHingeSurfInit elements are valid) (not used in retrieval) |
| FracLandPlusIce | 32-bit floating-point | None | Fraction of scene assumed by physical retrieval to be covered by land or ice |
| CldClearParam | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Cloud clearing parameter Eta. Positive values are cloudier than average for the FOR, negative values are clearer. |
| CC1_Noise_Amp | 32-bit floating-point | None | Internal retrieval quality indicator -- noise amplification factor from first cloud clearing because of extrapolation, dimensionless |
| Tsurf_4_CC1 | 32-bit floating-point | None | Internal retrieval quality indicator -- surface temperature used in first cloud clearing |
| TotCld_4_CC1 | 32-bit floating-point | None | Internal retrieval quality indicator -- total cloud fraction estimate before the first cloud clearing |
| CC1_RCode | 32-bit integer | None | Internal retrieval quality indicator -- return code from first cloud clearing. Nonzero when code did not execute to completion due to internal computational checks. Most commonly due to ill-conditioned matrices resulting from inadequate information content in observations |

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| CC2_RCode | 32-bit integer | None | Internal retrieval quality indicator -- return code from second cloud clearing. Nonzero when code did not execute to completion due to internal computational checks. Most commonly due to ill-conditioned matrices resulting from inadequate information content in observations |
| Phys_RCode | 32-bit integer | None | Internal retrieval quality indicator -- return code from physical retrieval. Nonzero when code did not execute to completion due to internal computational checks. Most commonly due to ill-conditioned matrices resulting from inadequate information content in observations |
| TotCld_below_500mb | 32-bit floating-point | None | Internal retrieval quality indicator -- estimated final cloud fraction due only to clouds below 500 hPa (as seen from above), dimensionless between zero and one |
| Phys_resid_AMSUA | 32-bit floating-point | ChanAMSUA (= 15) | Residual for AMSU-A channels after final retrieval (K) |
| Phys_resid_IR_window_790 | 32-bit floating-point | None | Residual for IR window channel near 790 cm**-1 after final retrieval (K) (No tuning applied because it is a surface channel) |
| Phys_resid_IR_window_844 | 32-bit floating-point | None | Residual for IR window channel near 844 cm**-1 after final retrieval (K) (No tuning applied because it is a surface channel) |
| Phys_resid_IR_window_917 | 32-bit floating-point | None | Residual for IR window channel near 917 cm**-1 after final retrieval (K) (No tuning applied because it is a surface channel) |
| Phys_resid_IR_window_1231 | 32-bit floating-point | None | Residual for IR window channel near 1231 cm**-1 after final retrieval (K) (No tuning applied because it is a surface channel) |

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| Phys_resid_IR_window_2513 | 32-bit floating-point | None | Residual for IR window channel near 2513 cm**-1 after final retrieval (K) (No tuning applied because it is a surface channel) |
| Phys_resid_IR_window_2616 | 32-bit floating-point | None | Residual for IR window channel near 2616 cm**-1 after final retrieval (K) (No tuning applied because it is a surface channel) |
| CBTmOBT1231 | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | End-to-end residual for window channel 1231.3 cm-1: computed cloudy brightness temperature for the retrieved atmospheric + cloud state minus angle-corrected observed L1B brightness temperature. (K) |
| CBTmOBT1231s | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Variant of CBTmOBT1231 but using substitute surface properties if those were used in cloud retrieval (i.e. cases where cld_surf_fallback = 1) (K) |
| CC_noise_eff_amp_factor | 32-bit floating-point | None | Effective amplification of noise in IR window channels due to extrapolation in cloud clearing and uncertainty of clear state. (< 1.0 for noise reduction, >1.0 for noise amplification, -9999.0 for unknown) |
| CC1_noise_eff_amp_factor | 32-bit floating-point | None | Equivalent of CC_noise_eff_amp_factor but from the first attempt at cloud clearing |
| CC1_Resid | 32-bit floating-point | None | Internal retrieval quality indicator -- residual between the first cloud cleared radiances for channels used in the determination and the radiances calculated from the best estimate of clear, in K |
| CCfinal_Resid | 32-bit floating-point | None | Internal retrieval quality indicator -- residual between the final cloud cleared radiances for channels used in the determination and the radiances calculated from the best estimate of clear, in K |

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| CCfinal_Noise_Amp | 32-bit floating-point | None | Internal retrieval quality indicator -- noise amplification factor from cloud clearing because of extrapolation, dimensionless. Note: the name is misleading: this is the value after the second cloud clearing iteration, not the last. |
| Tdiff_IR_MW_ret | 32-bit floating-point | None | Internal retrieval quality indicator -- layer mean difference in lower atmosphere between final IR temperature retrieval and the last internal MW-only temperature determination. High values suggest problems with MW or problems with cloud clearing. |
| Tdiff_IR_4CC1 | 32-bit floating-point | None | Internal retrieval quality indicator -- layer mean difference in lower atmosphere between final IR temperature retrieval and the temperature used in the first cloud clearing. |
| TSurfdiff_IR_4CC1 | 32-bit floating-point | None | Internal retrieval quality indicator -- absolute value of surface temperature difference between final IR retrieval and the surface temperature used as input in the first cloud clearing. |
| TSurfdiff_IR_4CC2 | 32-bit floating-point | None | Internal retrieval quality indicator -- absolute value of surface temperature difference between final IR retrieval and the surface temperature used as input in the second cloud clearing. |
| AMSU_Chans_Resid | 32-bit floating-point | None | Internal retrieval quality indicator -- residual of selected AMSU channels (currently channel 5 only) against that calculated from the final IR retrieval state, K. High values suggest lower atmosphere retrieval disagrees with MW due to problems with MW or cloud clearing. |
| TotCld_4_CCfinal | 32-bit | None | Internal retrieval quality |

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| | floating-point | | indicator -- total cloud fraction estimated before final cloud clearing (as seen from above), dimensionless between zero and one |
| Surf_Resid_Ratio | 32-bit floating-point | None | Internal retrieval quality indicator -- residuals of surface channels as compared to predicted uncertainty (dimensionless factor) |
| Temp_Resid_Ratio | 32-bit floating-point | None | Internal retrieval quality indicator -- residuals of temperature channels as compared to predicted uncertainty (dimensionless factor) |
| Water_Resid_Ratio | 32-bit floating-point | None | Internal retrieval quality indicator -- residuals of water channels as compared to predicted uncertainty (dimensionless factor) |
| Cloud_Resid_Ratio3x3 | 32-bit floating-point | AIRSTrack (= 3) * AIRSXTrack (= 3) | Internal retrieval quality indicator -- residuals of cloud channels as compared to predicted uncertainty (dimensionless factor) |
| Cloud_Resid_Ratio | 32-bit floating-point | None | Internal retrieval quality indicator -- residuals of cloud channels as compared to predicted uncertainty (mean of 9 values in Cloud_Resid_Ratio3x3) (dimensionless factor) |
| O3_Resid_Ratio | 32-bit floating-point | None | Internal retrieval quality indicator -- residuals of ozone channels as compared to predicted uncertainty (dimensionless factor) |
| CO_Resid_Ratio | 32-bit floating-point | None | Internal retrieval quality indicator -- residuals of carbon monoxide channels as compared to predicted uncertainty (dimensionless factor) |
| CH4_Resid_Ratio | 32-bit floating-point | None | Internal retrieval quality indicator -- residuals of methane channels as compared to predicted uncertainty (dimensionless factor) |

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| MWCheck_Resid_Ratio | 32-bit floating-point | None | Internal retrieval quality indicator -- residuals of channels used in MW check as compared to predicted uncertainty (dimensionless factor) |
| invalid | 8-bit integer | None | No valid output (1: True, 0: False, 255/-1: Unknown) |
| MW_ret_used | 8-bit integer | None | MW-only final retrieval used |
| bad_clouds | 8-bit integer | None | invalid cloud parameters |
| Start_Clim | 8-bit integer | None | Source of climatology used as initial state;<br>0: for None;<br>1: for NCEP/UARS;<br>2: for ECMWF land only;<br>3: for ECMWF sea only;<br>4: for ECMWF land + sea;<br>5: for ECMWF mixed surface fallback |
| Startup | 8-bit integer | None | Source of startup input atmospheric state used in first cloud clearing step.;<br>0: MW-only retrieval;<br>1: IR-Only cloudy regression;<br>2: IR+MW cloudy regression, with some info from MW-only physical retrieval;<br>3: Climatology;<br>4: Neural Network |
| cld_surf_fallback | 8-bit integer | None | cloud retrieval used a surface state from an earlier retrieval step |
| nchan_big_ang_adj | 16-bit integer | None | The number of good chans with an angle adjustment over 20 * noise level in at least one of the 6 angle-adjusted IR FOVs. |
| bad_l1b | 8-bit integer | None | Level 2 process not allowed due to bad level 1b data |
| bad_l1b_amsu | 8-bit integer | None | Bad AMSU-A level 1b data |
| bad_l1b_hsb | 8-bit integer | None | Bad HSB level 1b data |
| bad_l1b_airs | 8-bit integer | None | Bad AIRS level 1b data |
| bad_l1b_vis | 8-bit integer | None | Bad VIS level 1b data |
| forecast | 8-bit | None | Complete forecast guess |

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| | integer | | was used |
| no_psurf_guess | 8-bit integer | None | No surface pressure was available. Topography was used for surf press |
| bad_temps | 8-bit integer | None | invalid temp and surface skin temp |
| bad_h2o | 8-bit integer | None | invalid water vapor profile |
| bad_o3 | 8-bit integer | None | invalid ozone profile |
| bad_co | 8-bit integer | None | Invalid CO profile (profiles with bad_co = 1 had successful physical retrieval of CO but unsuccessful physical retrieval overall. These had climatology COCDSup. This value is no longer used. Profiles with bad_co = 2 have failed or not attempted physical CO retrieval and also have climatology in COCDSup) |
| no_tuning | 8-bit integer | None | Standard br temp tuning NOT applied |
| no_ang_corr | 8-bit integer | None | Standard angle correction NOT applied |
| no_mw | 8-bit integer | None | MW only retrieval not attempted |
| no_initial | 8-bit integer | None | First retrieval not attempted |
| no_final | 8-bit integer | None | Final retrieval not attempted |
| mw_fpe | 8-bit integer | None | floating-point exception in MW-Only retrieval step |
| cloudy_reg_fpe | 8-bit integer | None | floating-point exception in cloudy regression retrieval step |
| initial_fpe | 8-bit integer | None | floating-point exception in Initial retrieval step |
| final_fpe | 8-bit integer | None | floating-point exception in Final retrieval step |
| MWPrecip | 8-bit integer | None | Precipitation was detected over 0.5 mm/hr |
| MWsurf_T0 | 32-bit floating-point | None | low-frequency surface adjustment parameter -- T0 |
| MWsurf_Tinf | 32-bit floating-point | None | high-frequency surface adjustment parameter -- Tinfinity |

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| MWsecant_ratio | 32-bit floating-point | None | ratio of reflected to direct path length (only valid for mostly-water scenes) |
| MWseaice_conc | 32-bit floating-point | None | Fraction of field-of-view with frozen covering. For predominately water areas (landFrac < 0.5, MWSurfClass = 3,4) MWseaice_conc refers to sea ice and MWseaice_conc range is [0.05 ... (1.0 - landFrac)]. For predominately land areas (landFrac >= 0.5, MWSurfClass = 5,6,7) MWseaice_conc refers to snow/glacier and MWseaice_conc range is [0.0 ... 1.0]. Frozen surface of the minority element of a coastal field-of-view is not accounted for. Other surface classes have MWseaice_conc=0.0 |
| MWresidual_temp | 32-bit floating-point | None | sum of squares of temperature residuals normalized by channel sensitivities |
| MWresidual_mois | 32-bit floating-point | None | sum of squares of moisture residuals normalized by channel sensitivities |
| MWresidual_AMSUA | 32-bit floating-point | ChanAMSUA (= 15) | Brightness temperature residual for each AMSU-A channel (Kelvin) |
| MWresidual_HSB | 32-bit floating-point | ChanHSB (= 5) | brightness temperature residual for each HSB channel (Kelvin) |
| MWiter_temp | 8-bit integer | None | # of iterations of the temperature profile |
| MWiter_mois | 8-bit integer | None | # of iterations of the moisture profile |
| mw_ret_code | 8-bit integer | None | Return code status of MW retrieval: values can be summed if more than one applies:;<br>0 All OK;<br>1 Moisture variables rejected by residual test;<br>2 Troposphere temperature profile rejected by residual test;<br>4 Excessive liquid water; |

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| | | | 8 Insufficient valid channels;<br>16 Numerical error;<br>32 Emissivity > 1 for any AMSU-A channel;<br>64 Stratosphere temperature profile rejected by residual test;<br>128/-128 MW retrieval not attempted |
| sccnn_ret_code | 8-bit integer | None | Return code status of startup neural net retrieval:;<br>0 All OK;<br>1 Problem encountered; |
| cloudy_reg_ret_code | 8-bit integer | None | Return code status of startup cloudy regression retrieval: values can be summed if more than one applies:;<br>0 All OK;<br>1 Problem encountered;<br>16 Numerical error;<br>128/-128 Cloudy regression not attempted |
| Cloudy_Reg_FOV_chan | 16-bit integer | None | Channel number (1-2378) of channel used to select from among the 9 IR FOVs the one to be used in cloudy regression (-9999 for N/A) |
| Cloudy_Reg_FOV | 16-bit integer | None | FOV number of IR FOV used in cloudy regression (1-9, -9999 for N/A) |
| Cloudy_Reg_FOV_BT | 32-bit floating-point | None | Brightness temperature for channel Cloudy_Reg_FOV_chan at FOV Cloudy_Reg_FOV (K, -9999 for N/A) |
| Cloudy_Reg_Score | 32-bit floating-point | None | Indicator of how well the initial cloudy radiances match radiances reconstructed from cloudy eigenvectors. (Unitless ratio. should be ~1.0. >10.0 indicates a major problem) |
| cloud_ice | 8-bit integer | None | Scattering by cloud ice present in FOV |
| icc_too_cloudy | 8-bit integer | None | Initial cloud clearing pass too cloudy |
| icc_low_contrast | 8-bit integer | None | Initial cloud clearing pass contrast too low |
| icc_bad_rad | 8-bit integer | None | Initial cloud clearing pass cloud cleared radiances do not match clear guess - |

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| | | | reject the IR retrieval |
| icc_contrast | 32-bit floating-point | None | Initial cloud clearing contrast (units?) |
| bad_1st | 8-bit integer | None | The initial retrieval failed |
| bad_1st_surf | 8-bit integer | None | The initial surface retrieval failed |
| bad_1st_cc | 8-bit integer | None | The first cloud clearing failed |
| bad_1st_regres | 8-bit integer | None | The regression guess failed |
| bad_1st_phys | 8-bit integer | None | The first physical retrieval failed |
| fcc_too_cloudy | 8-bit integer | None | Final cloud clearing pass too cloudy |
| fcc_low_contrast | 8-bit integer | None | Final cloud clearing pass contrast too low |
| fcc_bad_rad | 8-bit integer | None | Final cloud clearing pass cloud cleared radiances do not match clear guess - reject the IR retrieval |
| fcc_contrast1 | 32-bit floating-point | None | Final cloud clearing contrast (units?) pass 1 |
| fcc_contrast2 | 32-bit floating-point | None | Final cloud clearing contrast (units?) pass 2 |
| bad_final | 8-bit integer | None | Final retrieval failed |
| bad_final_cc | 8-bit integer | None | final cloud clearing failed |
| bad_final_ir | 8-bit integer | None | final IR retrieval failed |
| bad_final_surf | 8-bit integer | None | final surface ret failed |
| bad_final_temp | 8-bit integer | None | final temp ret failed |
| bad_final_h2o | 8-bit integer | None | final water vapor ret failed |
| bad_final_o3 | 8-bit integer | None | final ozone ret failed |
| bad_final_cloud | 8-bit integer | None | final cloud ret failed |
| bad_cc_cld_ret | 8-bit integer | None | Cloud clearing and cloud ret are inconsistent |
| MW_IR_ret_differ | 8-bit | None | Microwave and IR |

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| | integer | | temperature retrieval differ too much - reject final IR retrieval |
| bad_MW_low_resid | 8-bit integer | None | Microwave residuals in lower atmosphere too large - reject final IR retrieval |
| MW_low_atm_resid | 32-bit floating-point | None | MW residual for lower atmosphere after final retrieval |
| final_AMSU_ret | 8-bit integer | None | 0 for success;<br>1 for did not converge;<br>2 for residual too large;<br>3 for retrieval step not attempted |
| final_HSB_ret | 8-bit integer | None | 0 for success;<br>1 for did not converge;<br>2 for residual too large;<br>3 for retrieval step not attempted |
| final_cloud_ret | 8-bit integer | None | 0 for success;<br>1 for did not converge;<br>2 for matrix inversion residual too large;<br>3 for retrieval step not attempted;<br>4 for singular matrix (unobservable quantity) |
| final_cloud_spot_ret3x3 | 8-bit integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | 0 for success;<br>1 for did not converge;<br>2 for matrix inversion residual too large;<br>3 for retrieval step not attempted;<br>4 for singular matrix (unobservable quantity) |
| final_surf_ret | 8-bit integer | None | 0 for success;<br>1 for did not converge;<br>2 for residual too large;<br>3 for retrieval step not attempted |
| final_temp_ret | 8-bit integer | None | 0 for success;<br>1 for did not converge;<br>2 for residual too large;<br>3 for retrieval step not attempted |
| final_h2o_ret | 8-bit integer | None | 0 for success;<br>1 for did not converge;<br>2 for residual too large;<br>3 for retrieval step not attempted |
| final_o3_ret | 8-bit | None | 0 for success; |

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| | integer | | 1 for did not converge;<br>2 for residual too large;<br>3 for retrieval step not attempted |
| final_ch4_ret | 8-bit integer | None | 0 for success;<br>1 for did not converge;<br>2 for residual too large;<br>3 for retrieval step not attempted |
| final_co_ret | 8-bit integer | None | 0 for success;<br>1 for did not converge;<br>2 for residual too large;<br>3 for retrieval step not attempted |
| final_co2_ret | 8-bit integer | None | 0 for success;<br>1 for did not converge;<br>2 for residual too large;<br>3 for retrieval step not attempted |
| bad_vis_rad | 8-bit integer | None | Vis/NIR radiance out of range |
| bad_vis_cal | 8-bit integer | None | Vis/NIR calibration data old or invalid |
| bad_vis_det_temp | 8-bit integer | None | Vis/NIR Detector temperature out of range |
| bad_scan_hd_temp | 8-bit integer | None | Scan Head Assembly temperature out of range |
| Initial_CC_score | 32-bit floating-point | None | Indicator of how well the initial cloud-cleared radiances match radiances reconstructed from clear eigenvectors. (Unitless ratio);<br>0.33 is best possible, a 3X noise reduction;<br><0.8 for a very good match;<br><3.0 for a pretty good match;<br>>10.0 indicates a major problem |
| Initial_CC_subscores | 32-bit floating-point | ScoresBand (= 10) | Sub-scores contributing to Initial_CC_score, by frequency band |
| sccnn_bt_corr | 32-bit floating-point | SccnnBtCorr (= 2) | Quality indicator based on amount of cloud clearing in the internal CC of the SCCNN algorithm. Lower absolute values are better. (K) |
| sccnn_bt_corr_freq | 32-bit floating-point | SccnnBtCorr (= 2) | Frequencies of channels used to compute sccnn_bt_corr (cm-1) |
| relayer_num_nonpos_coef_h2o | 32-bit | None | Internal indicator from |

| | | | |
|---|---|---|---|
| | integer | | relayering of water vapor: # of spline coefficients <= 0.0 - 1 if LSQ problem fails. |
| relayer_num_nonpos_coef_o3 | 32-bit integer | None | Internal indicator from relayering of ozone vapor: # of spline coefficients <= 0.0 - 1 if LSQ problem fails. |
| relayer_num_nonpos_coef_co | 32-bit integer | None | Internal indicator from relayering of carbon monoxide: # of spline coeffi cients <= 0.0 -1 if LSQ problem fails. |
| relayer_num_nonpos_coef_ch4 | 32-bit integer | None | Internal indicator from relayering of methane: # of spline coefficients <= 0.0 -1 if LSQ problem fails. |
| relayer_num_knots | 32-bit integer | None | Internal indicator from relayering of gases: # of knots in spline |
| relayer_degree | 32-bit integer | None | Internal indicator from relayering of gases: Degree of spline. Nominally 4 for cubic. |
| relayer_runge_kutta_bits | 32-bit integer | None | Internal indicator from relayering of gases: for temperature mass layer integrator, bit-mapped diagnostics of Runge-Kutta integrator;<br>0 - successful return;<br>2nd bit - Soft Error: This is being used inefficiently because the step size has been reduced drastically many times to get answers at many points.;<br>3rd bit - Soft Error: A considerable amount of work has been expended in the (primary) integration.;<br>4th bit - Soft Error: It appears that this problem is "stiff". ;<br>5th bit - Hard Error: It does not appear possible to achieve the accuracy specified by TOL and THRES;<br>6th bit - Hard Error: The global error assessment may not be reliable beyond the current integration point. |
| Num_Fill_Chan_Cloudy_Reg | 16-bit integer | None | Number of channels the cloudy regression processing |

| | | | |
|---|---|---|---|
| | | | step determined to be of low quality and calculated substitute values for before proceeding. |
| Num_Fill_Chan_SCCNN | 16-bit integer | None | Number of channels the SCCNN processing step determined to be of low quality and calculated substitute values for before proceeding. |
| Num_Fill_Chan_Ang_Adj | 16-bit integer | None | Number of channels the local angle adjustment processing step determined to be of low quality and calculated substitute values for before proceeding. |
| Doppler_shift_ppm | 32-bit floating-point | None | Doppler shift for this footprint in parts per million. |
| spectral_clear_indicator | 16-bit integer | AIRSTrack (= 3) * AIRSXTrack (= 3) | Flag telling whether scene was flagged as clear by a spectral filter. Only ocean filter is validated;<br>2: Ocean test applied and scene identified as clear;<br>1: Ocean test applied and scene not identified as clear;<br>0: Calculation could not be completed. Possibly some inputs were missing or FOV is on coast or on the edge of a scan or granule;<br>-1: Unvalidated land test applied and scene not identified as clear;<br>-2: Unvalidated land test applied and scene identified as clear |
| num_clear_spectral_indicator | 16-bit integer | None | Number of 9 IR FOVs which are clear according to spectral_clear_indicator. -1 when the spectral clear indicator could not be applied to any of the spots. Note that the spectral clear indicator is not validated for land scenes. |

# A1-12. L1C AIRS Science Interface Specification

Interface Specification Version 6.1.0.0

2014-10-20

ESDT ShortName = "AIRICRAD"

DOI = “10.5067/AQUA/AIRS/DATA101”

Swath Name = "L1C_AIRS_Science"

Level = "level1C"

# Footprints = 90

# scanlines per scanset = 3

## *Dimensions*

### These fields define all dimensions that can be used for HDF-EOS swath fields.

**The names "GeoTrack" and "GeoXTrack" have a special meaning for this document: "Cross-Track" data fields have a hidden dimension of "GeoXTrack"; "Along-Track" data fields have a hidden dimension of "GeoTrack"; "Full Swath Data Fields have hidden dimensions of both "GeoTrack" and "GeoXTrack".**

| Name | Value | Explanation |
|---|---|---|
| GeoXTrack | 90 | Dimension across track for footprint positions. Same as number of footprints per scanline. -- starting at the left and increasing towards the right as you look along the satellite's path |
| GeoTrack | # of scan lines in swath | Dimension along track for footprint positions. Same as number of scanlines in granule. Parallel to the satellite's path, increasing with time. (Nominally 45 for Level-2, AMSU-A, and AIRS/Vis low-rate engineering; 135 for AIRS/Vis and HSB high-rate quantities) |
| Channel | 2645 | Dimension of channel array (This list of channels removes the overlaps and fills the gaps found in the 2378-channel set from the AIRS instrument.) |
| L1bChannel | 2378 | Dimension of channel array used in L1B. (In this list channels are generally in order of increasing wavenumber, but because frequencies can vary and because all detectors from a physical array of detector elements (a "module") are always grouped together there are sometimes small reversals in frequency order where modules overlap.) |

## *Geolocation Fields*

**These fields appear for every footprint (GeoTrack * GeoXTrack times) and correspond to footprint center coordinates and "shutter" time.**

| Name | Explanation |
|---|---|
| Latitude | Footprint boresight geodetic Latitude in degrees North (-90.0 ... 90.0) |
| Longitude | Footprint boresight geodetic Longitude in degrees East (-180.0 ... 180.0) |
| Time | Footprint "shutter" TAI Time: floating-point elapsed seconds since Jan 1, 1993 |

## *Attributes*

**These fields appear only once per granule and use the HDF-EOS "Attribute" interface**

| Name | Type | Explanation |
|---|---|---|
| processing_level | string of 8-bit characters | Zero-terminated character string denoting processing level ("level1C") |
| instrument | string of 8-bit characters | Zero-terminated character string denoting instrument ("AIRS") |
| DayNightFlag | string of 8-bit characters | Zero-terminated character string set to "Night" when the subsatellite points at the beginning and end of a granule are both experiencing night according to the "civil twilight" standard (center of refracted sun is below the horizon). It is set to "Day" when both are experiencing day, and "Both" when one is experiencing day and the other night. "NA" is used when a determination cannot be made. |
| AutomaticQAFlag | string of 8-bit characters | Zero-terminated character string denoting granule data quality: (Always "Passed", "Failed", or "Suspect") |
| NumTotalData | 32-bit integer | Total number of expected scene footprints |
| NumProcessData | 32-bit integer | Number of scene footprints which are present and can be processed routinely (state = 0) |
| NumSpecialData | 32-bit integer | Number of scene footprints which are present and can be processed only as a special test (state = 1) |
| NumBadData | 32-bit integer | Number of scene footprints which are present but cannot be processed (state = 2) |
| NumMissingData | 32-bit integer | Number of expected scene footprints which are not present (state = 3) |
| NumLandSurface | 32-bit integer | Number of scene footprints for which the surface is more than 90% land |
| NumOceanSurface | 32-bit | Number of scene footprints for which the surface is less |

| | | |
|---|---|---|
| | integer | than 10% land |
| node_type | string of 8-bit characters | Zero-terminated character string denoting whether granule is ascending, descending, or pole-crossing: ("Ascending" and "Descending" for entirely ascending or entirely descending granules, or "NorthPole" or "SouthPole" for pole-crossing granules. "NA" when determination cannot be made.) |
| start_year | 32-bit integer | Year in which granule started, UTC (e.g. 1999) |
| start_month | 32-bit integer | Month in which granule started, UTC (1 ... 12) |
| start_day | 32-bit integer | Day of month in which granule started, UTC (1 ... 31) |
| start_hour | 32-bit integer | Hour of day in which granule started, UTC (0 ... 23) |
| start_minute | 32-bit integer | Minute of hour in which granule started, UTC (0 ... 59) |
| start_sec | 32-bit floating-point | Second of minute in which granule started, UTC (0.0 ... 59.0) |
| start_orbit | 32-bit integer | Orbit number of mission in which granule started |
| end_orbit | 32-bit integer | Orbit number of mission in which granule ended |
| orbit_path | 32-bit integer | Orbit path of start orbit (1 ... 233 as defined by EOS project) |
| start_orbit_row | 32-bit integer | Orbit row at start of granule (1 ... 248 as defined by EOS project) |
| end_orbit_row | 32-bit integer | Orbit row at end of granule (1 ... 248 as defined by EOS project) |
| granule_number | 32-bit integer | Number of granule within day (1 ... 240) |
| num_scansets | 32-bit integer | Number of scansets in granule (1 ... 45) |
| num_scanlines | 32-bit integer | Number of scanlines in granule (3 * num_scansets) |
| start_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees North (-90.0 ... 90.0) |
| start_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at start of granule (subsatellite location at midpoint of first scan) in degrees East (-180.0 ... 180.0) |
| start_Time | 64-bit floating-point | TAI Time at start of granule (floating-point elapsed seconds since start of 1993) |
| end_Latitude | 64-bit floating-point | Geodetic Latitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees North (-90.0 ... 90.0) |

| | | |
|---|---|---|
| end_Longitude | 64-bit floating-point | Geodetic Longitude of spacecraft at end of granule (subsatellite location at midpoint of last scan) in degrees East (-180.0 ... 180.0) |
| end_Time | 64-bit floating-point | TAI Time at end of granule (floating-point elapsed seconds since start of 1993) |
| eq_x_longitude | 32-bit floating-point | Longitude of spacecraft at southward equator crossing nearest granule start in degrees East (-180.0 ... 180.0) |
| eq_x_tai | 64-bit floating-point | Time of eq_x_longitude in TAI units (floating-point elapsed seconds since start of 1993) |
| LonGranuleCen | 16-bit integer | Geodetic Longitude of the center of the granule in degrees East (-180 ... 180) |
| LatGranuleCen | 16-bit integer | Geodetic Latitude of the center of the granule in degrees North (-90 ... 90) |
| LocTimeGranuleCen | 16-bit integer | Local solar time at the center of the granule in minutes past midnight (0 ... 1439) |
| num_fpe | 16-bit integer | Number of floating point errors |
| orbitgeoqa | 32-bit unsigned integer | See Appendix D |
| num_satgeoqa | 16-bit integer | Number of scans with problems in satgeoqa |
| num_glintgeoqa | 16-bit integer | Number of scans with problems in glintgeoqa |
| num_moongeoqa | 16-bit integer | Number of scans with problems in moongeoqa |
| num_ftptgeoqa | 16-bit integer | Number of footprints with problems in ftptgeoqa |
| num_zengeoqa | 16-bit integer | Number of footprints with problems in zengeoqa |
| num_demgeoqa | 16-bit integer | Number of footprints with problems in demgeoqa |
| Rdiff_swindow_M1a_chan | 16-bit integer | Array M1a channel used as one reference in calculating Rdiff_swindow. (index into radiance & frequency arrays 1...2378) |
| Rdiff_swindow_M2a_chan | 16-bit integer | Array M2a channel used as one reference in calculating Rdiff_swindow. (index into radiance & frequency arrays 1...2378) |
| Rdiff_lwindow_M8_chan | 16-bit integer | Array M8 channel used as one reference in calculating Rdiff_lwindow. (index into radiance & frequency arrays 1...2378) |
| Rdiff_lwindow_M9_chan | 16-bit integer | Array M9 channel used as one reference in calculating Rdiff_lwindow. (index into radiance & frequency arrays 1...2378) |
| CF_Version | string of 8- | Cloud Filter Version Identification. Identifies the set of |

| | | |
|---|---|---|
| | bit characters | thresholds used in determination of spectral_clear_indicator. |
| NumSaturatedFOVs | 16-bit unsigned integer | Number of scene fields-of-view (out of a nominal 1350) in which the downlinked counts overflowed. |
| NumUnderflowFOVs | 16-bit unsigned integer | Number of scene fields-of-view (out of a nominal 1350) in which the downlinked counts underflowed. |
| NumCalFOVsOutOfBounds | 16-bit unsigned integer | Number of calibration fields-of-view (out of a nominal 810) in which the downlinked counts underflowed or overflowed. |
| NumSO2FOVs | 16-bit unsigned integer | Number of fields-of-view (out of a nominal 1350) with a signifcant SO2 concentration based on the value of BT_diff_SO2. |
| granules_present | string of 8-bit characters | Zero-terminated character string denoting which adjacent granules were available for smoothing ("All" for both previous & next, "Prev" for previous but not next, "Next" for next but not previous, "None" for neither previous nor next) |

## *Per-Granule Data Fields*

### These fields appear only once per granule and use the HDF-EOS "Field" interface

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| nominal_freq | 32-bit floating-point | Channel (= 2645) | Nominal frequencies (cm**-1) of each channel |
| ChanID | 16-bit unsigned integer | Channel (= 2645) | A unique identifier for each channel. For those channels which are present in Level-1B this identifier is identical to the 1-based index of the channel in Level-1B. For channels which are addidn in Level-1C to fill gaps in the Level-1B record, this is a unique identifier with value > 2378. Note: ChanID are not sequential. |
| ChanMapL1b | 16-bit integer | L1bChannel (= 2378) | A map from the 2378-channel Level-1B channel set into the 2645-channel Level-1C set. For Level-1B channels which are used in Level-1C, this will be a number in [1,2645] giving the 1-based index in the Level-1C list for this channel. For Level-1B channels which are not used in Level-1C, this will be -1. |
| L1cNumSynth | 32-bit unsigned integer | Channel (= 2645) | A count of how many spectra in the granule have synthesized values (cleaned or filled) for each channel. Fill channels will always have value 12150 (=90*135) |

## *Along-Track Data Fields*

### These fields appear once per scanline (GeoTrack times)

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| satheight | 32-bit floating-point | None | Satellite altitude at nadirTAI in km above reference ellipsoid (e.g. 725.2) |
| satroll | 32-bit floating-point | None | Satellite attitude roll angle at nadirTAI (-180.0 ... 180.0 angle about the +x (roll) ORB axis, +x axis is positively oriented in the direction of orbital flight completing an orthogonal triad with y and z.) |
| satpitch | 32-bit floating-point | None | Satellite attitude pitch angle at nadirTAI (-180.0 ... 180.0 angle about +y (pitch) ORB axis. +y axis is oriented normal to the orbit plane with the positive sense opposite to that of the orbit's angular momentum vector H.) |
| satyaw | 32-bit floating-point | None | Satellite attitude yaw angle at nadirTAI (-180.0 ... 180.0 angle about +z (yaw) axis. +z axis is positively oriented Earthward parallel to the satellite radius vector R from the spacecraft center of mass to the center of the Earth.) |
| glintlat | 32-bit floating-point | None | Solar glint geodetic latitude in degrees North at nadirTAI (-90.0 ... 90.0) |
| glintlon | 32-bit floating-point | None | Solar glint geodetic longitude in degrees East at nadirTAI (-180.0 ... 180.0) |
| nadirTAI | 64-bit floating-point | None | TAI time at which instrument is nominally looking directly down. (between footprints 15 & 16 for AMSU or between footprints 45 & 46 for AIRS/Vis & HSB) (floating-point elapsed seconds since start of 1993) |
| sat_lat | 64-bit floating-point | None | Satellite geodetic latitude in degrees North (-90.0 ... 90.0) |
| sat_lon | 64-bit floating-point | None | Satellite geodetic longitude in degrees East (-180.0 ... 180.0) |
| scan_node_type | 8-bit integer | None | 'A' for ascending, 'D' for descending, 'E' when an error is encountered in trying to determine a value. |
| satgeoqa | 32-bit unsigned integer | None | See Appendix D |
| glintgeoqa | 16-bit unsigned integer | None | See Appendix D |
| moongeoqa | 16-bit unsigned | None | See Appendix D |

| | | | |
|---|---|---|---|
| | integer | | |

## *Full Swath Data Fields*

### These fields appear for every footprint of every scanline in the granule (GeoTrack * GeoXTrack times)

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| radiances | 32-bit floating-point | Channel (= 2645) | Radiances for each channel in milliWatts/m**2/cm**-1/steradian |
| scanang | 32-bit floating-point | None | Scanning angle of AIRS instrument with respect to the AIRS Instrument for this footprint (-180.0 ... 180.0, negative at start of scan, 0 at nadir) |
| satzen | 32-bit floating-point | None | Spacecraft zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| satazi | 32-bit floating-point | None | Spacecraft azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| solzen | 32-bit floating-point | None | Solar zenith angle (0.0 ... 180.0) degrees from zenith (measured relative to the geodetic vertical on the reference (WGS84) spheroid and including corrections outlined in EOS SDP toolkit for normal accuracy.) |
| solazi | 32-bit floating-point | None | Solar azimuth angle (-180.0 ... 180.0) degrees E of N GEO) |
| sun_glint_distance | 16-bit integer | None | Distance (km) from footprint center to location of the sun glint (-9999 for unknown, 30000 for no glint visible because spacecraft is in Earth's shadow) |
| topog | 32-bit floating-point | None | Mean topography in meters above reference ellipsoid |
| topog_err | 32-bit floating-point | None | Error estimate for topog |
| landFrac | 32-bit floating-point | None | Fraction of spot that is land (0.0 ... 1.0) |
| landFrac_err | 32-bit floating-point | None | Error estimate for landFrac |
| ftptgeoqa | 32-bit unsigned | None | See Appendix D |

| | | | |
|---|---|---|---|
| | integer | | |
| zengeoqa | 16-bit unsigned integer | None | See Appendix D |
| demgeoqa | 16-bit unsigned integer | None | See Appendix D |
| state | 32-bit integer | None | Data state: 0:Process, 1:Special, 2:Erroneous, 3:Missing |
| Rdiff_swindow | 32-bit floating-point | None | Radiance difference in the 2560 cm**-1 window region used to warn of possible errors caused by scene non-uniformity and misalignment of the beams: radiance(Rdiff_swindow_M1a_chan) - radiance(Rdiff_swindow_M2a_chan). (radiance units) |
| Rdiff_lwindow | 32-bit floating-point | None | Radiance difference in the longwave window(850 cm**-1) used to warn of possible errors caused by scene non-uniformity and misalignment of the beams: radiance(Rdiff_lwindow_M8_chan) - radiance(Rdiff_lwindow_M9_chan). (radiance units) |
| SceneInhomogeneous | 8-bit unsigned integer | None | Threshold test for scene inhomogeneity, using band-overlap detectors (bit fields).;<br>Bit 7 (MSB, value 128): scene is inhomogeneous, as determined by the Rdiff_swindow threshold. For v5.0 the test is abs(Rdiff_swindow) > 5 * sqrt(NeN(Rdiff_swindow_M1a_chan)^2 + NeN(Rdiff_swindow_M2a_chan));<br>Bit 6 (value 64): scene is inhomogeneous, as determined by the Rdiff_lwindow threshold. For v5.0 the test is abs(Rdiff_lwindow) > 5 * sqrt(NeN(Rdiff_lwindow_M8_chan)^2 + NeN(Rdiff_lwindow_M9_chan));<br>Bits 5-0: unused (reserved) |
| dust_flag | 16-bit integer | None | Flag telling whether dust was detected in this scene;<br>1: Dust detected;<br>0: Dust not detected;<br>-1: Dust test not valid because of land;<br>-2: Dust test not valid because of high latitude;<br>-3: Dust test not valid because of suspected cloud;<br>-4: Dust test not valid because of bad input data |
| dust_score | 16-bit integer | None | Dust score. Each bit results from a different test comparing radiances. Higher scores indicate more certainty of dust present. Dust probable when score is over 380. Not valid when dust_flag is negative. |
| spectral_clear_indicator | 16-bit integer | None | Flag telling whether scene was flagged as clear by a spectral filter. Only ocean filter is validated; |

| | | | |
|---|---|---|---|
| | | | 2: Ocean test applied and scene identified as clear;<br>1: Ocean test applied and scene not identified as clear;<br>0: Calculation could not be completed. Possibly some inputs were missing or FOV is on coast or on the edge of a scan or granule;<br>-1: Unvalidated land test applied and scene not identified as clear;<br>-2: Unvalidated land test applied and scene identified as clear |
| BT_diff_SO2 | 32-bit floating-point | None | Brightness temperature difference Tb(1361.44 cm-1) - Tb(1433.06 cm-1) used as an indicator of SO2 release from volcanoes. Values under -6 K have likely volcanic SO2. (Kelvins) |
| AB_Weight | 8-bit integer | Channel (= 2645) | A/B detector weights;<br>-1: Channel radiance is an approximate value synthesized by cleaning or filling;<br>0: A weight = B weight;<br>1: A side only;<br>2: B side only |
| L1cProc | 8-bit unsigned integer | Channel (= 2645) | Bit field, by channel, for the current spectrum. Zero means the channel was unchanged in Level-1C.;<br>Bit 7 (MSB, value 128): This is a synthesized fill channel where the AIRS instrument does not have a detector;<br>Bit 6: (value 64) Cleaned. See L1cCleanReason for the cause;<br>Bit 5: (value 32) Shifted frequency (not used in release 6.0);<br>Bit 4: (value 16) radiometric correction applied (not used in release 6.0);<br>Bit 3: (value 8) unused/reserved (value 0);<br>Bit 2: (value 4) unused/reserved (value 0);<br>Bit 1: (value 2) unused/reserved (value 0);<br>Bit 0: (LSB, value 1) Output value is a dummy/filler value because data is missing or otherwise could not be processed. |
| L1cSynthReason | 8-bit unsigned integer | Channel (= 2645) | 0: value is preserved from Level-1B;<br>1: Filled because this channel falls in a gap between AIRS instrument modules;<br>2: Cleaned because this channel is known to be of low quality;<br>3: Cleaned because of bad (-9999.0) Level-1B radiance value;<br>4: Cleaned because of high Level-1B NeN noise measurement;<br>5: Cleaned because Level-1B reported a zero or negative value in the NeN noise measurement indicating that the channel is in too poor a state for noise level to be measured effectively;<br>6: Cleaned because the telemetry, gain, offset, or pop flag bits were set in Level-1B CalFlag (not |

| | | | |
|---|---|---|---|
| | | | used);<br>7: Cleaned because Level-1B radiance is unphysically hot;<br>8: Cleaned because Level-1B radiance is unphysically cold;<br>9: Cleaned because Level-1B radiance is hotter than expected based on the radiances of correlated channels;<br>10: Cleaned because Level-1B radiance is colder than expected based on the radiances of correlated channels;<br>11: Cleaned because Level-1B radiance is significantly increased by scene spatial inhomgeneity;<br>12: Cleaned because Level-1B radiance is significantly decreased by scene spatial inhomgeneity;<br>100: Cleaned by runtime user command (Test mode only) |
| NeN | 32-bit floating-point | Channel (= 2645) | Noise-equivalent Radiance (radiance units) for an assumed 250 K scene. Channels which have synthesized radiances will have a flag value of 999.0. |
| Inhomo850 | 32-bit floating-point | None | Brightness temperature difference for the adjacent edges of the M-08 and M-09 detector modules. (frequency near 850 cm-1) This is a double difference using a PC reconstructed spectrum. Absolute values over ~0.84 indicate likely impact from spatial scene inhomgeneity (K) |

# Appendix A2. AIRS-Suite Match-Up Product Interface Specification

ESDT ShortNames=
"AIRX2MAT", "AIRX2MTL",
"AIRH2MAT", "AIRH2MTL",
"AIRS2MAT", "AIRS2MTL"

DOIs =

"10.5067/AQUA/AIRS/DATA217", "10.5067/AQUA/AIRS/DATA220",

"10.5067/AQUA/AIRS/DATA218", "10.5067/AQUA/AIRS/DATA221",

"10.5067/AQUA/AIRS/DATA219", "10.5067/AQUA/AIRS/DATA222"

This HDF-EOS Swath product can contain up to eight swaths as follows:

- L1B_AIRS_Science
- L1B_VIS_Science
- L1B_AMSU
- L1B_HSB
- L2_Standard_atmospheric&surface_product
- L2_Support_atmospheric&surface_product
- L2_Standard_cloud-cleared_radiance_product
- Matchup_Info
- GCML2
- GCMMatchup

Any number of these swaths may be missing, but, if present, all have the same size on their primary dimension (GeoTrack). There is a one-to-one correspondence between items at the same GeoTrack index in each swath.

The dimension GeoTrack has a slightly different meaning for swaths in the match-up file than for swaths in standard AIRS PGE products. For the latter files, it corresponds to the number of instrument scans that took place during the period when this data was being collected. For the match-up file, it means the total number of AIRS-suite profiles ("golfballs") contained in the file. Because this file is a collection of profiles for which truth matches happened to be found, no assumptions should be made about the geographic relations between profiles.

# Appendix A2. AIRS-Suite Match-Up Product Interface Specification

Except for GCML2, GCMMatchup, and Matchup_Info, each swath follows the interface specification in the "AIRS Processing Files Description" document for the corresponding swath file with the following changes:

- All Attributes (which are once per file in the standard swath files) become fields with dimensions GeoTrack + listed Extra Dimensions.
- For "big-spot" swaths (L1B_AMSU, all L2):
    - Dimension GeoXTrack is removed.
    - Fields which were Along-Track have the same dimensions (GeoTrack + listed Extra Dimensions)
    - Fields which were Full Swath have the same dimensions, except that the second dimension (GeoXTrack) is removed. (Dimensions are now GeoTrack + listed Extra Dimensions.)
- For "small-spot" swaths (L1B_HSB, L1B_AIRS_Science, L1B_VIS_Science):
    - Dimension GeoXTrack is replaced by SubTrack3x3 and SubXTrack3x3 (both always set to 3).
    - Fields which were Along-Track have one extra dimension inserted after GeoTrack, SubTrack3x3. (Dimensions are now GeoTrack,SubTrack3x3 + listed Extra Dimensions.)
    - Fields which were Full Swath have the same dimensions except that the second dimension (GeoXTrack) is replaced by two dimensions, SubTrack3x3, SubXTrack3x3. (Dimensions are now GeoTrack,SubTrack3x3,SubXTrack3x3 + listed Extra Dimensions.)
- There are two additional 32-bit integer fields dimensioned GeoTrack.
    - start_scan_line_number contains the scan line number (1-based) of the first footprint in its original granule. (GeoTrack)
    - start_footprint_number contains the footprint number (1-based) of the first footprint in its original granule. (GeoXTrack)
- Geolocation Fields have only the dimension GeoTrack. For small-spot swaths this corresponds to the center footprint. These small-spot swaths have additional 64-bit floating-point Full Swath fields named footprint_latitude, footprint_longitude, and footprint_taitime which contain the per-footprint geolocation information.
- The fields listed below are removed because they give granule-level information that is not useful in a match-up context (When '*' is the last character then it matches all fields with that start of a name.):
    - num_*
    - processing_level
    - instrument
    - AutomaticQAFlag
    - NumTotalData
    - NumProcessData
    - NumMissingData
    - NumSpecialData
    - NumBadData
    - node_type
    - start_year

- start_month
- start_day
- start_hour
- start_minute
- start_sec
- start_Latitude
- start_Longitude
- start_Time
- end_Latitude
- end_Longitude
- end_Time
- stat_*
- QA_*
- granules_present
- gain_fit_dev
- rad_stats
- rad_scan_stats
- rad_unc_stats
- offset_unc_stats
- offset_stats
- limit_offsets
- offset_fit_dev
- input_*
- NeN_stats
- polar_stat
- limit_*
- offset_begin
- offset_end
- offset_err
- gain
- offset
- nominal_freq
- spectral_freq_prev
- DCR_*
- effective_bb_temp
- nadir_contrast
- spec_*
- gain_*
- bulb_failed
- K21
- K32
- K31
- K_factors_applied
- gamma_*
- track_err
- xtrack_err

- align_*
- cal_coef_*
- IF_offset_*
- bandwidth
- center_freq
- CalGranSummary
- CalScanSummary
- SpaceViewDelta
- spaceview_selection
- NumRefChannels
- RefChannels
- NumLandSurface
- NumOceanSurface
- start_orbit_row
- end_orbit_row
- LonGranuleCen
- LatGranuleCen
- LocTimeGranuleCen
- MoonInViewMWCount
- DCRCount
- PopCount
- VISDarkAMSUFOVCount
- VISBrightAMSUFOVCount
- primary_bulb
- secondary_bulb
- backup_bulb
- NumVisInvalid
- NumMWStratIrRetOnly
- MWHingeSurfFreqGHz
- CF_Version
- nFOV_big_ang_adj
- NumNoHSB
- NumNoAMSUA
- NumNoAIRS
- NumNoVis
- pressH2O
- pressStd
- pressSupp

The Matchup_Info swath will have the swath attributes described in Table 1:

**Table 1. Matchup_Info Swath Attributes**

| Name | Type | Explanation |
|---|---|---|
| ***Truth_File_Type*** | String of 8-bit characters | Free-format text (up to 80 characters) giving match-up criteria for Truth_Type. For example, match-all, match-exact: TYP:120,match-substring:T29:11,exclude-substring:ITP:52,exclude-exact:T29:11. |
| ***Modification_History*** | String of 8-bit characters | Free-format text (up to 80 characters) gives the modification history of this file. For instance, it might contain "hand-modified by EMM to increase time window for ocean records." Suggested value is "N/A" for no modification. |

Matchup_Info contains space for up to 5 matches for each value of GeoTrack. This reflects the possibility that more than one truth record can be within the specified time and distance window of a truth observation. If there are fewer than 5 matches, the remaining match structures will be marked invalid by having all characters of the truth_type field NUL (zero).

The HDF-EOS Matchup_Info swath will contain the dimensions in Table 2:

**Table 2. HDF-EOS Matchup-Info Swath Dimensions**

| Name | Value | Explanation |
|---|---|---|
| ***GeoTrack*** | # of profiles | The total number of AIRS-suite profiles (golfballs) contained in the file (same as for all other swaths) |
| ***MaxMatch*** | 5 (TBD) | Maximum number of truth profiles matched to one AIRS golfball |
| ***SubTrack3x3*** | 3 | Number of along-track spots per profile for small-spot swaths (L1B AIRS, VIS, HSB, GCMMatchup) |
| ***SubXTrack3x3*** | 3 | Number of across-track spots per profile for small-spot swaths (L1B AIRS, VIS, HSB, GCMMatchup) |
| ***MaxString*** | 80 | Maximum number of characters in a string |
| ***LongString*** | 255 | Maximum number of characters for Truth_File_UR and Truth_File_Name |

The Matchup_Info swath will have geolocation fields Latitude, Longitude, Time with dimensions GeoTrack,MaxMatch.

For each match, the fields in Table 3 will be present. In the HDF-EOS Matchup_Info swath, each field below, except Truth_File_*, will have dimensions GeoTrack,MaxMatch (Truth_File_* have dimension GeoTrack) before the specified Extra Dimensions.

**Table 3. HDF-EOS Matchup_Info Swath Fields**

| *Name* | *Type* | *Extra Dimensions* | *Explanation* |
|---|---|---|---|
| ***delta_sec*** | 32-bit integer | None | Time difference (in seconds) between taking of truth data and AIRS-suite observations. Positive for AIRS data taken first. -99999999 for unknown |
| ***dist_amsu*** | 32-bit floating point | None | Distance (km) between location of AMSU-A observations & of truth. |
| ***Truth_File_Type*** | String of 8-bit characters | MaxString (=80) | This item contains the type of truth file being matched. It must always exactly match one of these valids:<br>PREPQC.ADPUPA ADP upper air radiosonde records from PREPQC. This is the only valid value under operational circumstances at GDAAC.<br>ARM/CART ARM/CART site (TBD) Surface Marine records.<br>NONE No truth file.<br>OTHER Other. |
| ***Truth_File_Name*** | String of 8-bit characters | LongString (=255) | This item contains the filename of the file matched. When Truth_File_Type= NONE or OTHER, this field can contain the identity of the originator of this request or inforation about the purpose of this experiment. Maximum: 255 characters |
| ***Truth_File_UR*** | String of 8-bit characters | LongString (=255) | This is the Universal Reference (UR) for the file named in Truth_File_Name=. It is ignored when Truth_File_Type= NONE. |
| ***Truth_File_Version*** | String of 8-bit characters | MaxString (=80) | This is the TBD versioning information about the truth file. It is ignored when Truth_File_Type= NONE. |

| *Name* | *Type* | *Extra Dimensions* | *Explanation* |
|---|---|---|---|
| ***Truth_Type*** | String of 8-bit characters | MaxString (=80) | String uniquely identifying truth profile type. For files with Truth_File_Type PREPQC.ADPUPA, Truth_Type contains a string of the form TYP:typ,T29:t29,ITP:itp where typ, t29, and itp are replaced by the values of these Table B entries:<br><br>TYP: OI/SSI REPORT TYPE<br>T29: NMC OFFICE NOTE 29 REPORT TYPE<br>ITP: INSTRUMENT TYPE<br><br>Other values will be designated for other types of truth. All characters NUL (0) denote no match-up present at this MaxMatch index. |
| ***Profile_Id*** | String of 8-bit characters | MaxString (=80) | String uniquely identifying truth profile within the truth file. For PREPQC data this will be the SIDsid, where "sid" will be replaced by the SID from the PREPQC record. |
| ***Profile_Index*** | 32-bit integer | | Index uniquely identifying truth profile within the truth file. For PREPQC data this will be the SQN (TBD). |
| ***Quality_Indicator*** | String of 8-bit characters | MaxString (=80) | Up to 80-character string indicating the quality of a given truth record. Definitions are:<br>PREPQC.ADPUPA Number of levels at which this profile has valid temperatures.<br>ARM/CART TBD |

The GCML2 and GCMMatchup swaths will share the dimensions in Table 4.

**Table 4. GCML2 and GCMMatchup Swath Dimensions**

| *Name* | *Value* | *Explanation* |
|---|---|---|
| ***GeoTrack*** | # of profiles | The total number of AIRS-suite profiles (golfballs) contained in the file. (same as for all other swaths) |
| ***GCM_T_NLEV*** | 26 | The maximum number of temperature levels in GCM profile |
| ***GCM_H2O_NLEV*** | 21 | The maximum number of h2o levels in GCM profile |
| ***GCM_LW_NLEV*** | 21 | The maximum number of liquid water levels in GCM profile |
| ***GCM_OZO_NLEV*** | 6 | The maximum number of ozone levels in GCM profile |
| ***GCM_CLD_NLEV*** | 3 | The maximum number of cloud layers |
| ***GCM_NFileMax*** | 100 | The maximum number of GCM files needed to generate the swath |
| ***In addition, the GCML2 swath will contain:*** | | |
| ***SubTrack3x3*** | 3 | Number of along-track spots per profile for small-spot swaths (L1B AIRS, VIS, HSB, GCMMatchup) |
| ***SubXTrack3x3*** | 3 | Number of across-track spots per profile for small-spot swaths (L1B AIRS, VIS, HSB, GCMMatchup) |
| ***And the GCMMatchup swath will contain:*** | | |
| ***MaxMatch*** | 5 (TBD) | Maximum number of truth profiles matched to one AIRS golfball |

The GCML2 and GCMMatchup will have a common set of attributes, defined in Table 5.

For the following attributes: integer values are set to 0 and strings are set to " if GCM_File_Number=0 or the index over file_number > GCM_File_Number. (file_number goes from 1 to GCM_NFileMax)

NCEP ON388 refers to NCEP Office Note 388, "GRIB, The WMO Format for the StorageProduct Information," 1998/03/10.

**Table 5. GCML2 and GCMMatchup Common Attributes**

| *Name* | *Type* | *Dimension* | *Explanation* |
|---|---|---|---|
| ***GCM_Number_File*** | 32-bit integer | 1 | The number of GCM file processes in this run, must be smaller than GCM_NfileMax |
| ***GCM_File_Name*** | String | ***GCM_NfileMax (=100)*** | The names of the GCM files |
| ***GCM_Year*** | 32-bit integer | ***GCM_NfileMax (=100)*** | The year of the run of the GCM files |
| ***GCM_Month*** | 32-bit integer | ***GCM_NfileMax (=100)*** | The month of the run of the GCM files |
| ***GCM_Day*** | 32-bit integer | ***GCM_NfileMax (=100)*** | The day of the run of the GCM files |
| ***GCM_RunTime*** | 16-bit integer | ***GCM_NfileMax (=100)*** | The hour of the run of the GCM files, e.g., 0, 6, 12, 18 |
| ***GCM_Forecast_Time*** | 16-bit integer | ***GCM_NfileMax (=100)*** | The forecast time in hours from the run time, e.g., 0, 3, 6, 9… |
| ***GCM_Forecast_TAI*** | 64-bit floating-point | ***GCM_NfileMax (=100)*** | The forecast date and time as TAI93: floating-point seconds since start of 1993 |
| ***GCM_Center*** | String | 1 | The processing center for the GCM, (see Table 0 of NCEP ON388) values will include (may be expanded):<br><br>NCEP<br>ECMWF<br>DAO |
| ***GCM_SubCenter*** | 16-bit integer | 1 | The division within the processing center, from GRIB PDS 26 (see Table C of NCEP ON388) |
| ***GCM_Process*** | 16-bit integer | 1 | Generating Process or Model, from GRIB PDS B6 (see Table A, NCEP ON388), nominally 96 for AVN forecasts/analyses |

| Name | Type | Dimension | Explanation |
|---|---|---|---|
| ***GCM_GridType*** | 16-bit integer | 1 | Grid ID of output (GRIB PDS B7, see Table 7, NCEP ON388), nominally 3 for global AVN forecast/analysis |
| ***P_Temp*** | 32-bit floating-point | | Pressure levels of the GCM temperature profiles (hPa) |
| ***P_H2O*** | 32-bit floating-point | | Pressure levels of the GCM water vapor profiles (hPa) |
| ***P_Ozone*** | 32-bit floating-point | | Pressure levels of the GCM ozone profiles (hPa) |
| ***P_CloudH2O*** | 32-bit floating-point | | Pressure levels of the GCM cloud water profiles (hPa) |

The GCML2 swath will contain one state for each AIRS footprint, therefore it is dimensioned (GeoTrack, SubTrack3x3, SubXTrack3x3). Fields are dimensioned (GeoTrack, SubTrack3x3, SubXTrack3x3, Dim), where Dim is listed in Table 6.

The GCMMatchup swath will contain one state per matchup, dimensioned (GeoTrack, MaxMatch). Fields are dimensioned (GeoTrack, MaxMatch, Dim), where Dim is listed in Table 6 (Dimensions of 1 are ignored.).

Table 6 defines the fields in a state.

**Table 6. State Fields**

| Name | Type | Dimension | Explanation |
|---|---|---|---|
| ***Location_Source*** | 16-bit integer | 1 | The location type to which the GCM is interpolated: 1=AIRS, 2=V/NIR, 3=HSB, 4=AMSU, -1=N/A. Only for GCML2, not GCMMatchup |
| ***P_surf*** | 32-bit floating-point | 1 | The surface pressure (hPa) |
| ***P_sealvl*** | 32-bit floating-point | 1 | The sea level surface pressure (hPa) |
| ***Ice_Cover*** | 16-bit floating-point | 1 | Fractional coverage of ice from spatial interpolation of ice flag |
| ***Land_Flag*** | 16-bit floating-point | 1 | Fractional amount of land from spatial interpolation of land flag |

| Name | Type | Dimension | Explanation |
|---|---|---|---|
| ***T_surf*** | 32-bit floating-point | 1 | The surface skin temperature (K) |
| ***H_surf*** | 32-bit floating-point | 1 | The surface elevation (m) |
| ***Albedo_surf*** | 32-bit floating-point | 1 | The surface visible albedo (%) |
| ***T_surf_air*** | 32-bit floating-point | 1 | The surface air temperature (K) |
| ***Soil_water*** | 32-bit floating-point | 1 | Volumetric fraction of soil moisture |
| ***h2o_surf_mmr*** | 32-bit floating-point | 1 | The surface water mass mixing ratio |
| ***Total_Ozone*** | 32-bit floating-point | 1 | Total Ozone (Dobson) |
| ***Water_burden*** | 32-bit floating-point | 1 | Precipitable water (kg/m^2) |
| ***U_10*** | 32-bit floating-point | 1 | The zonal wind speed 10m above surface (m/s) |
| ***V_10*** | 32-bit floating-point | 1 | The meridional wind speed 10m above surface (m/s) |
| ***T_AIR*** | 32-bit floating-point | GCM_T_NLEV (=26) | The air temperature profile (K) |
| ***H2O_mmr*** | 32-bit floating-point | GCM_H2O_NLEV (=21) | The water vapor mass mixing ratio profile |
| ***Cloud_water*** | 32-bit floating-point | GCM_LW_NLEV (=21) | The cloud liquid water mass mixing ratio in gm/kg, negative if cloud ice |
| ***Ozo_vmr*** | 32-bit floating-point | GCM_OZO_NLEV (=6) | The ozone volume mixing ratio profile |
| ***CldFrac*** | 32-bit floating-point | GCM_CLD_NLEV (=3) | The cloud fraction for each layer, 0 if clouds are absent (0-1). This is the total cloud fraction and not the viewed fraction observed by AIRS. |
| ***Pcldtop*** | 32-bit floating-point | GCM_CLD_NLEV (=3) | The cloud top pressure (hPa) |
| ***Pcldbot*** | 32-bit floating-point | GCM_CLD_NLEV (=3) | The cloud bottom pressure (hPa) |

States are interpolated to the locations of Match-up and AIRS footprints, using linear interpolation in time, bilinear interpolation in latitude and longitude. Flags are set to one if any of the corners are 1, e.g., there might be ice or land contamination.

GCM fields for time interpolation are from the same run and do not include the analysis, i.e., we use the 3, 6 and 9 hour forecasts, but never the 0 hour forecast.

The above fields are set to Bad_Float (-9999.0) or Bad_Integer (-9999) if bounding forecasts are unavailable. Bounding forecasts are separated by 3 hours and bracket the time of the footprint, or match-up

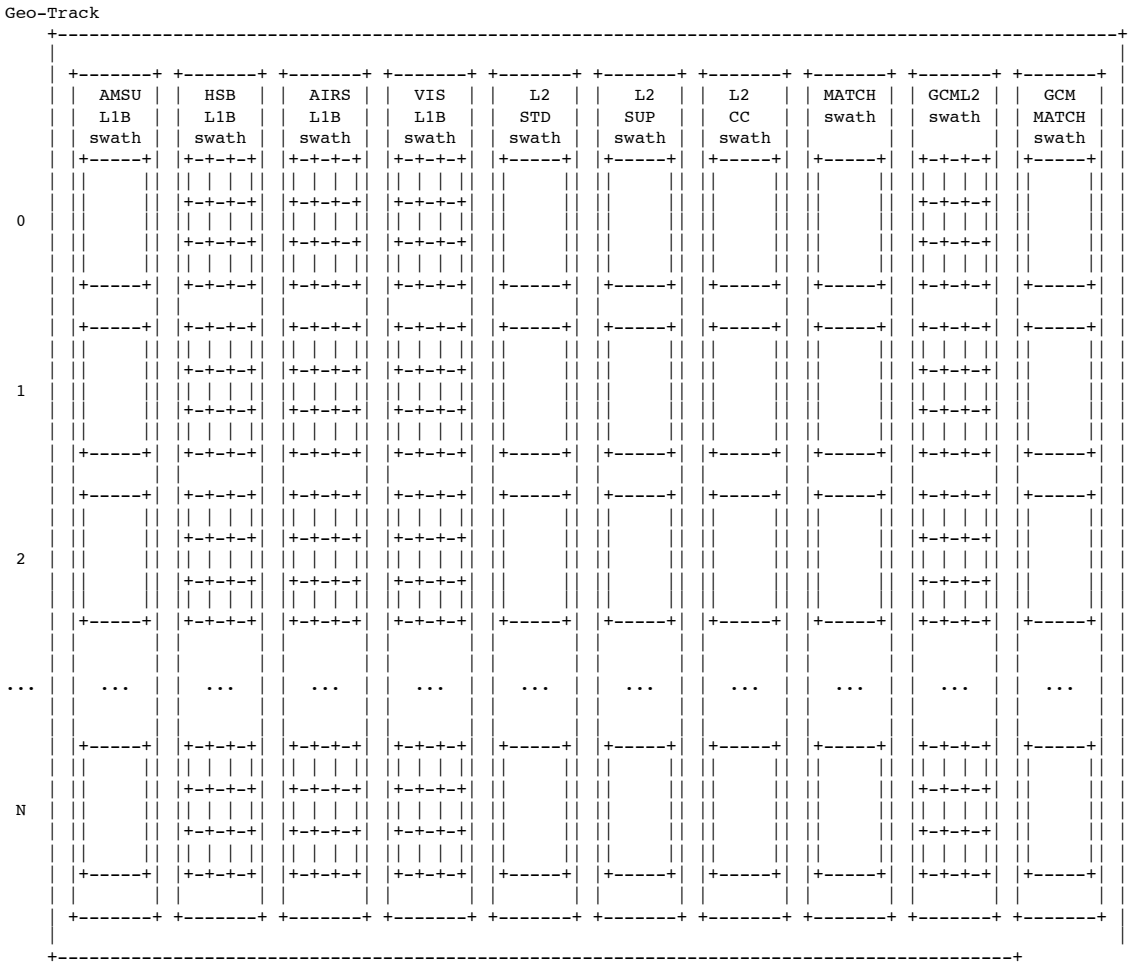


**Figure 1. Conceptual Layout of Match-Up File**

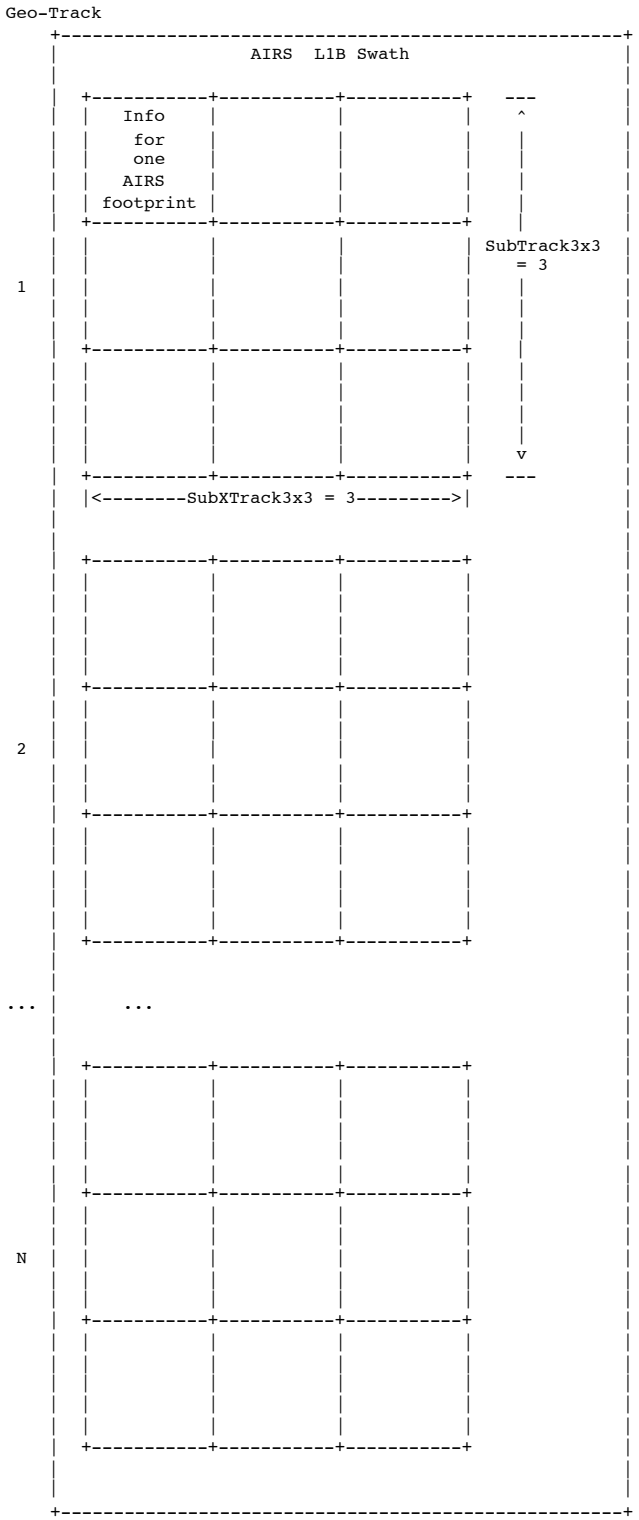


**Figure 2. Close-up of AIRS L1B Swath, HSB L1B Swath, GCML2**

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# Appendix A3. AIRS-Suite Calibration Subset Product Interface Specification

The AIRS-Suite Calibration Subset file aids in verifying the calibration of AIRS, AMSU and VIS channels relative to truth on the earth's surface.

Each file covers a 24-hour period from midnight to midnight UTC, and for certain spots during that day extracts AIRS IR and VIS radiances, AMSU-A brightness temperatures, and predicted sea surface temperatures. AMSU-A data are interpolated to the location of the AIRS footprint. For the VIS data, only the mean and the standard deviation of the 8x9 pixel grid are saved.

The file contains information associated with AIRS footprints selected if they match any of three criteria:

1. A footprint is cloud-free according to a series of tests.
2. The center of a footprint lies within 30 nautical miles of a calibration site.
3. A footprint contains very high clouds and is within +/-60 degrees latitude.

In addition, isolated near-nadir footprints are selected at random in such a way that a globally balanced coverage is achieved. (Regular sampling would over-represent polar regions.)

The output file is organized in two separate pseudo-swaths called “L1B_AIRS_Cal_Subset” and “L1B_AIRS_Cal_Subset_Gran_Stats”.

“L1B_AIRS_Cal_Subset” contains the bulk of the data. It is not a true “swath” of complete scans, each containing a fixed number of footprints. Instead, individual footprints are selected, in time order, from scans covering multiple granules.

“L1B_AIRS_Cal_Subset_Gran_Stats” contains a number of statistics on a per-granule basis. It covers 241 granules - 239 full granules of the subject day, plus those portions of the preceding and following granules that lie within the subject day (between 00:00:00.000 and 23:59:59.999).

Their dimensions, attributes and geolocation and data fields are described below.

**Swath** L1B_AIRS_Cal_Subset

**Table 1. L1B_AIRS_Cal_Subset Dimensions**

| Name | Value | Explanation |
|---|---|---|
| GeoTrack | variable | The number of CalSubset footprints contained in swath L1B_AIRS_Cal_Subset (equal to attribute "fp_count"). |
| IR_Channel | 2378 | The number of AIRS IR channels. Frequencies are given in field nominal_freq. |
| VIS_Channel | 3 | The number of VIS channels.<br>Channel 1: ~0.4 micron<br>Channel 2: ~0.6 micron<br>Channel 3: ~0.8 micron<br>(The VIS/NIR instrument also has a 4$^{th}$ broadband channel, but that is not used here.) |
| AMSU_Channel | 15 | The number of AMSU-A channels.<br>Channel 1: 23.8 GHz<br>Channel 2: 31.4 GHz<br>Channel 3: 50.3 GHz<br>Channel 4: 52.8 GHz<br>Channel 5: 53.596 +/- 0.115 GHz<br>Channel 6: 54.4 GHz<br>Channel 7: 54.94 GHz<br>Channel 8: 55.5 GHz<br>Channel 9: f0<br>Channel 10: f0 +/- 0.217 GHz;<br>Channel 11: f0 +/- df +/- 48 MHz<br>Channel 12: f0 +/- df +/- 22 MHz<br>Channel 13: f0 +/- df +/- 10 MHz<br>Channel 14: f0 +/- df +/- 4.5 MHz<br>Channel 15: 89 GHz<br>f0 = 57290.344 MHz<br>df = 322.4 MHz |

**Table 2. L1B_AIRS_Cal_Subset Attributes**

| Name | Number of Occurrences or Dimensions | Data Type | Explanation |
|---|---|---|---|
| CF_Version | 1 | char-8 | Cloud Filter Version Identification<br>Collectively identifies the set of thresholds used for cloud filtering and the distinction between day/night and land/water. The individual thresholds values are given in Table 6. |
| start_year | 1 | int-32 | Start Year (eg. 2007)<br>This field and the date and time fields following reflect the date/time of the earliest possible footprint that may be found in the output file. |
| start_month | 1 | int-32 | Start Month (1-12) |
| start_day | 1 | int-32 | Start Day of the Month (1-31) |
| start_hour | 1 | int-32 | Start Hour |
| start_minute | 1 | int-32 | Start Minute |
| start_sec | 1 | int-32 | Start Second |
| fp_count | 1 | int-32 | Footprint Count<br>Total count of footprints |
| Clear | 1 | int-32 | "Clear" Footprint Count<br>Count of footprints selected by the "cloud-free" thresholds (Selection Algorithm #1) - total for day/night and land/water |
| Clear_DL | 1 | int-32 | "Clear" Footprint Count - day/land<br>The distinction between spacecraft day and spacecraft night is based on the solar zenith angle (the angle at the center of a footprint between zenith and the sun) and a day/night threshold angle (see "th_solzen_day" in Table 6). The distinction between "land" and "water" is based on the fraction of land seen in a FOV and a threshold value (see "th_landfrac" in Table 6). The threshold values are input arguments to the Clear Match PGE. |
| Clear_DW | 1 | int-32 | "Clear" Footprint Count - day/water |
| Clear_NL | 1 | int-32 | "Clear" Footprint Count - night/land |
| Clear_NW | 1 | int-32 | "Clear" Footprint Count - night/water |
| CalSite | 1 | int-32 | Calibration Site Footprint Count<br>Count of footprints selected from calibration sites (Selection Algorithm #2) - total for day/night and land/water |
| CalSite_DL | 1 | int-32 | CalSite Footprint Count - day/land |
| CalSite_DW | 1 | int-32 | CalSite Footprint Count - day/water |
| CalSite_NL | 1 | int-32 | CalSite Footprint Count - night/land |
| CalSite_NW | 1 | int-32 | CalSite Footprint Count - night/water |
| HiCloud | 1 | int-32 | High Clouds Footprint Count<br>Count of footprints viewing high clouds over non-polar regions (Selection Algorithm #3) - total for day/night and land/water |
| HiCloud_DL | 1 | int-32 | High Clouds Count - day/land |
| HiCloud_DW | 1 | int-32 | High Clouds Count - day/water |

| Name | Number of Occurrences or Dimensions | Data Type | Explanation |
|---|---|---|---|
| HiCloud_NL | 1 | int-32 | High Clouds Count - night/land |
| HiCloud_NW | 1 | int-32 | High Clouds Count - night/water |
| Random | 1 | int-32 | Random Footprint Count<br>Count of nadir footprints selected at random (Algorithm #4) - total for day/night and land/water<br>(Actually only the center footprint of a 9-footprint "golfball" is selected at random. The surrounding 8 footprints are then added.) |
| Random_DL | 1 | int-32 | Random Count - day/land |
| Random_DW | 1 | int-32 | Random Count - day/water |
| Random_NL | 1 | int-32 | Random Count - night/land |
| Random_NW | 1 | int-32 | Random Count - night/water |

**Table 3. L1B_AIRS_Cal_Subset Geolocation Fields**

These fields exist for every footprint selected.

| Name | Data Type | Explanation |
|---|---|---|
| Latitude | float-64 | Footprint Latitude<br>in degrees North (-90.0 to 90.0) |
| Longitude | float-64 | Footprint Longitude<br>in degrees East (-180.0 to 180.0) |
| Time | float-64 | Footprint Time<br>in TAI (elapsed seconds since January 1, 1993 00:00Z UTC) |

**Table 4. Data Fields Appearing Once**

The following data fields are produced once:

| Name | Number of Occurrences or Dimensions | Data Type | Explanation |
|---|---|---|---|
| nominal_freq | IR_Channel | float-32 | Nominal IR Channel "Frequencies"<br>in $cm^{-1}$ units |

**Table 5. Data Fields Associated with Every Footprint**

These fields exist for every footprint selected.

| Name | Number of Occurrences or Dimensions | Data Type | Explanation |
|---|---|---|---|
| granule_number | GeoTrack | int-16 | The granule from which the footprint was selected (range: 0 - 240). "0'' identifies Granule 240 of the preceding day. |
| scan | GeoTrack | int-16 | Scan number (range: 1 - 135) |
| footprint | GeoTrack | int-16 | Footprint number (range: 1 - 90) |
| reason | GeoTrack | int-16 | Footprint Selection Reason. Identifies the reason for the footprint's selection as follows:<br>1 = Clear (cloud-free) location<br>2 = Calibration site identified by field "site".<br>4 = High clouds<br>8 = Randomly selected location<br>Note: Footprints may be selected for more than one reason. In that case the reason codes are combined (bitwise or'd). |

| | | | |
|---|---|---|---|
| site | GeoTrack | int-16 | If the footprint was selected because it is near a calibration site (reason = 2), this field identifies the site as follows:<br>0 = footprint selection reason is not "calibration site"<br>1 = Egypt 1<br>Lat: 27.12°N, Lon: 026.10°E<br>2 = Simpson Desert<br>Lat: 24.50°S, Lon: 137.00°E<br>3 = Dome Concordia<br>Lat: 75.10°S, Lon: 123.40°E<br>4 = Mitu, Columbia<br>Lat: 01.50°N, Lon: 069.50°W<br>5 = Boumba, Cameroon<br>Lat: 03.50°N, Lon: 014.50°E<br>6 = Railroad Valley, NV<br>Lat: 38.50°N, Lon: 115.70°W<br>7 = SPG/Arm-Cart, OK<br>Lat: 36.60°N, Lon: 97.50°W<br>8 = Manus, Bismarck Archipelago<br>Lat: 02.00°S, Lon: 147.40°E<br>9 = Nauru, Micronesia<br>Lat: 00.50°S, Lon: 166.60°E<br>10 = North Pole<br>Lat: 90.00°N, Lon: N/A<br>11 = South Pole<br>Lat: 90.00°S, Lon: N/A<br>12 = Surgut, Siberian tundra<br>Lat: 61.15°N Lon: 73.37°E<br>13 = Yunnan rain forest<br>Lat: 23.90°N Lon:100.50°E<br>14 = Barrow, Alaska<br>Lat: 71.32°N Lon:156.66°W<br>15 = Atqusuk, Alaska<br>Lat: 70.32°N Lon:156.67°W<br>16 = Darwin, Australia<br>Lat: 12.42°S Lon:130.89°E<br>17 = Lake Qinghai, China<br>Lat: 36.75°N Lon:100.33°E<br>18 = Dunhuang, Gobi desert<br>Lat: 40.17°N Lon: 94.33°E<br>19 = Lake Titicaca<br>Lat: 15.88°S Lon: 69.33°W<br>20 = Lake Tahoe, CA<br>Lat: 39.10°N Lon: 120.04°W |
| scan_node_type | GeoTrack | char | Node Type<br>Consists of a single character:<br>"A" = ascending node (day)<br>"D" = descending node (night)<br>"N" = north pole<br>"S" = south pole<br>"Z" = not available |

| | | | |
|---|---|---|---|
| satzen | GeoTrack | float-32 | Satellite Zenith Angle<br>Angle between satellite and zenith at footprint location in degrees [0.0, 90.0]<br>-9999.0 means "not available". |
| solzen | GeoTrack | float-32 | Solar Zenith Angle<br>Angle between sun and zenith at footprint location in degrees [0 .0, 180.0]<br>-9999.0 means "not available". |
| topog | GeoTrack | float-32 | Mean elevation or "topography" at the center of the reference ellipsoid, in units of meters above mean sea level.<br>-9999.0 means "not available". |
| satheight | GeoTrack | float-32 | Satellite altitude above nadir in km.<br>-9999.0 means "not available". |
| sun_glint_distance | GeoTrack | int-16 | Distance, in km, from footprint center to the location of the sun glint during the sunlit portion of the orbit. "30000" indicates the spacecraft is in the earth's shadow.<br>-9999 means "not available". |
| LandFrac | GeoTrack | float-32 | Land Fraction<br>Fraction of surface identified to be land [0.0, 1.0]<br>-9999.0 means "not available". |
| radiances | GeoTrack<br>*<br>IR_Channel | float-32 | AIRS IR radiances for each channel for the selected footprint. Given in units of<br>mW / $m^2$ / $cm^{-1}$ / steradian<br>-9999.0 means "not available". |
| VisMean | GeoTrack<br>*<br>VIS_Channel | float-32 | Mean Radiances - VIS Channels<br>This is the mean of the 72 samples for VIS channels 1 - 3.<br>Given in units of<br>W / $m^2$ / $\mu$m / steradian<br>-9999.0 means "not available". |
| VisStdDev | GeoTrack<br>*<br>VIS_Channel | float-32 | Standard Deviation - VIS Channels<br>This is the standard deviation of the 72 samples for VIS channels 1 - 3.<br>-9999.0 means "not available". |
| avnsst | GeoTrack | float-32 | Sea Surface Temperature derived from the nearest (in time) two of six 3-hour Aviation Forecasts. The forecast times are T21Z of the previous day, T03Z, T09Z, T15Z, T21Z, and T03Z of the next day. The forecasts give the temperatures for a 1-degree grid. The derived temperature (K) is interpolated<br>1. for latitude<br>2. for longitude<br>3. for time<br>-9999.0 means "not available". |
| cx2616 | GeoTrack | float-32 | Output of the spatial coherence test at 2616 $cm^{-1}$. For cloud-free data cx2616 < 0.7K over water and<br>cx2616 < 2.0 K over land.<br>-9999.0 means "not available". |

| | | | |
|---|---|---|---|
| cx1231 | GeoTrack | float-32 | Output of the spatial coherence test at 1231 $cm^{-1}$. Given in K.<br>For cloud-free data cx1231 < 10.0 K<br>-9999.0 means "not available".<br>See Note 1, below. |
| cx2395 | GeoTrack | float-32 | Output of the spatial coherence test at 2395 $cm^{-1}$<br>Given in K.<br>-9999.0 means "not available".<br>See Note 1, below. |
| cxq2 | GeoTrack | float-32 | Output of the spatial coherence test for total water vapor, using the bt2616 - bt2607 proxy<br>Given in K.<br>For cloud-free data cxq2 < 1.0 K<br>-9999.0 means "not available".<br>See Note 1, below. |
| cxlpn | GeoTrack | float-32 | Output of the spatial coherence test for the pseudo lapse rate lp, where:<br>lp = (bt2395-bt2392) * $(\cos sza)^{0.3}$,<br>where sza is the satellite zenith angle,<br>Given in K.<br>-9999.0 means "not available".<br>See Note 1, below. |
| bt1231 | GeoTrack | float-32 | Brightness Temperature - 1231 $cm^{-1}$<br>in K.<br>-9999.0 means "not available". |
| sst1231r5 | GeoTrack | float-32 | Surface Temperature - 1231 $cm^{-1}$<br>This is the surface skin temperature (day and night) for surfaces with emissivity 0.98. This is a good approximation at 1231 $cm^{-1}$ for non-frozen water, land surfaces covered by vegetation, snow and ice.<br>Calculated per footprint as:<br>sst1231r5 = bt1231 + 0.28<br>+ (1.2 * q3)<br>+ $(0.2962 * q3)^2$<br>+ (1.0489 / cos(sza))<br>where:<br>q3=bt1231-bt1227 and<br>sza is the scan zenith angle.<br>Given in K.<br>-9999.0 means "not available".<br>Validated to 0.5K over liquid water. |
| lp2395clim | GeoTrack | float-32 | Pseudo lapse rate threshold applied in testing for cloud-free conditions. |
| amsu_bt | GeoTrack<br>*<br>AMSU_Channel | float-32 | AMSU-A antenna temperatures<br>in K. (Note: When the AMSU-A L1B data set includes side-lobe corrected antenna temperatures, as planned for Version 5, this field will reflect those corrected temperatures.)<br>-9999.0 means "not available".<br>Interpolated from 45 X 30 footprint AMSU-A swath to 135 X 90 footprint AIRS swath. |

| | | | |
|---|---|---|---|
| amsu_topog | GeoTrack | float-32 | Mean elevation or "topography", in units of meters above mean sea level.<br>-9999.0 means "not available".<br>Interpolated from 45 X 30 footprint AMSU-A swath to 135 X 90 footprint AIRS swath. |
| amsu_landFrac | Geotrack | float-32 | Land Fraction<br>Fraction of surface identified to be land [0.0, 1.0]<br>-9999.0 means "not available".<br>Interpolated from 45 X 30 footprint AMSU-A swath to 135 X 90 footprint AIRS swath. |
| dust_flag | Geotrack | int16 | Flag telling whether dust was detected in this scene;<br>1: Dust detected;<br>0: Dust not detected;<br>-1: Invalid (due to land);<br>-2: Invalid (due to high latitude);<br>-3: Invalid (due to suspected cloud);<br>-4: Invalid (due to bad input data) |
| BT_diff_SO2 | Geotrack | float32 | Brightness temperature difference BT(1361.44 cm-1) - BT(1433.06 cm-1) used as an indicator of SO2 release from volcanoes. Values under -6 K have likely volcanic SO2.<br>-9999.0 means "not available". |

Note 1: Parameters cx1231, cx2395 test the spatial coherence at 1231 $cm^{-1}$and at 2395 $cm^{-1}$. Parameter cxq2 tests the spatial coherence of the total water (bt2616-bt2607), and parameter cxlpn tests the spatial coherence of the pseudo lapse rate (bt2395-bt2392). These test are used to identify how cloudy the special locations are which did not pass the cx2616<0.7K spatial coherence clear test.

**Table 6. Threshold Values for Cloud Filter Version CF-973**

| Name | Explanation | Values<br>L = over land<br>W = over water<br>D = at day<br>N = at night |
|---|---|---|
| th_solzen_day | solzen threshold to distinguish S/C day and night | day: < 90.0<br>night: => 90.0 |
| th_landfrac | landfrac threshold to distinguish between land and water | land: => .01<br>water: < .01 |
| th_scor | spatial coherence threshold | L: < 2.0<br>W: < 0.7 |
| th_2392 | surface temperature difference threshold applied against the difference between sst1231r5 and sst2392r1 | L: >-15.0<br>W: > -2.0 |
| th_btq2 | threshold applied against the bt2616 – bt2607 difference | > 0.1 |
| th_cxq2 | threshold applied against the most extreme among the 5-FOV bt2616 – bt2607 gradients | < 1.0 |
| th_cx1231 | threshold applied against the most extreme difference among the 5-FOV bt1231 | < 10.0 |
| th_g5n | threshold applied against the g5n quantity (glint-filtered bt2616 – bt2508 difference) | LD: < 6.0<br>WD: < 2.5<br>LN: < 1.2<br>WN: < 1.2 |
| th_btg5n | minimum threshold for the g5n quantity | > 0.5 |

Additional thresholds for the pseudo lapse rate, based on geographical position, are obtained from ancillary files.

**Swath** L1B_AIRS_Cal_Subset

**Table 7. L1B_AIRS_Cal_Subset_Gran_Stats Dimensions**

| Name | Value | Explanation |
|---|---|---|
| Grans_plus_1 | 241 | The number of granules per day, plus 1. |

**Table 8. L1B_AIRS_Cal_Subset_Gran_Stats Data Fields**

The following data fields are produced once for each granule. For the first and last granules, which start on the preceding day and end on the following day, only the portion that lies within the current day (data day) is evaluated.

The individual fields are collected from groups of individual footprints differentiated as follows:

Group 1 includes all AIRS IR footprints encountered in the input data stream that lie inside the "data day" and for which the "state" flag indicates "process".

Group 2 includes all AIRS footprints of Group 1 that also match the day/night and land/water criteria established for the majority of a granule's footprints. (See fields mean_land_flag and mean_day_flag.)

Group 2a includes all footprints of Group 2 representing "clear" FOV's

Group 2b includes all footprints of Group 2 representing "high clouds"

Some of the values below are hypothetical counts of spectra that would have been selected as "clear", had different spatial coherence thresholds been selected. The nomenclature used in the "Explanation" field below is as follows:

th is the applicable spatial coherence threshold. Its value for land and water are defined in Table 6 (see "th_scor")

tht1 is the applicable threshold, tightened by one step (whereby one step is 0.2 over water and 0.5714 over land)

thr1 is the applicable threshold, relaxed by one step

thr2 is the applicable threshold, relaxed by two steps

| Name | Sel. from Grp | Data Type | Extra Dimension | Explanation |
|---|---|---|---|---|
| center_latitude | 1 | float-64 | None | Latitude of granule center (-90 to 90). |
| center_longitude | 1 | float-64 | None | Longitude of granule center (-180 to 180). |
| mean_day_flag | 1 | int-16 | None | Indicates whether the majority of AIRS footprints in the input data stream lie on the day or night side. 0 = night |

| | | | | |
|---|---|---|---|---|
| | | | | 1 = day<br>-1 = unknown<br><br>Note that this flag refers to footprints examined in the input data stream - not footprints included in the output data stream (i.e., this file). |
| mean_land_flag | 1 | int-16 | None | Indicates whether the majority of AIRS footprints in the input data stream lie over land or over water.<br>0 = water<br>1 = land<br>-1 = unknown |
| cnt_in | 2 | int-16 | None | Total number of AIRS footprints in the input data stream that form the majority (i.e., match both the mean_day_flag and the mean_land_flag) |
| cnt_clear | 2a | int-16 | None | Count of input majority footprints representing clear FOV's |
| cnt_hi_clouds | 2b | int-16 | None | Count of input majority footprints representing high clouds |
| cnt_cx2616_th_excl | 2 | int-16 | None | Count of input footprints which pass the test (exclusively):<br>cx2616 < th,<br>where th is the applicable threshold value. Only this test is made. The other tests that normally must be passed to declare a footprint as "clear" are excluded. |
| cnt_cx2616_q2_th_excl | 2 | int-16 | None | Count of input footprints which pass the tests (exclusively):<br>cx2616 < th,<br>q2 < th<br>where th is the applicable threshold value |
| cnt_cx2616_tht1_excl | 2 | int-16 | None | Count of input footprints which pass the test (exclusively):<br>cx2616 < tht1,<br>where tht1 is the applicable threshold value, tightened by one step |
| cnt_cx2616_q2_tht1_excl | 2 | int-16 | None | Count of input footprints which pass the tests (exclusively):<br>cx2616 < tht1,<br>q2 < th<br>where th is the applicable threshold value and tht1 is the threshold value, tightened by one step |
| cnt_cx2616_thr1_incl | 2 | int-16 | None | Count of input footprints which would have passed all tests (inclusively), had the test: |

| | | | | |
|---|---|---|---|---|
| | | | | cx2616 < thr1,<br>used a threshold value relaxed by one step |
| cnt_cx2616_q2_thr1_incl | 2 | int-16 | None | Count of input footprints which would have passed all tests (inclusively), had the tests:<br>cx2616 < thr1,<br>q2 < th<br>used a threshold value relaxed by one step |
| cnt_cx2616_thr2_incl | 2 | int-16 | None | Count of input footprints which would have passed all tests (inclusively), had the test:<br>cx2616 < thr2,<br>used a threshold value relaxed by two steps |
| cnt_cx2616_q2_thr2_incl | 2 | int-16 | None | Count of input footprints which would have passed all tests (inclusively), had the tests:<br>cx2616 < thr2,<br>q2 < th<br>used a threshold value relaxed by two steps |
| sst1231_gfs_mean | 2a | float-32 | None | Difference between the surface skin temperature calculated using bt1231 and the predicted GFS SST – Mean |
| sst1231_gfs_stddev | 2a | float-32 | None | Difference between the surface skin temperature calculated using bt1231 and the predicted GFS SST -<br>Standard Deviation |
| lp_mean | 2a | float-32 | None | Pseudo Lapse Rate - Mean |
| lp_stddev | 2a | float-32 | None | Pseudo Lapse Rate – Standard Deviation |
| q3_mean | 2a | float-32 | None | q3 – Mean<br>where q3 is the difference between bt1231 and bt1227 |
| q3_stddev | 2a | float-32 | None | q3 – Standard Deviation |
| bt1231_min | 2 | float-32 | None | bt1231 - Minimum |
| bt1231_max | 2 | float-32 | None | bt1231 - Maximum |
| bt1231_median | 2 | float-32 | None | bt1231 - Median |
| lp_min | 2 | float-32 | None | Pseudo Lapse Rate – Minimum |
| lp_max | 2 | float-32 | None | Pseudo Lapse Rate – Maximum |
| lp_median | 2 | float32 | None | Pseudo Lapse Rate - Median |
| d_sst1231_gfs_mean | 2 | float-32 | None | abs(sst1231 – gfssst) - mean |
| cnt_d_sst1231_gfs_lt_2 | 2 | int-16 | None | Count of footprints having abs(sst1231 – gfssst) < 2 K |
| cnt_d_sst1231_gfs_gt_5 | 2 | int-16 | None | Count of footprints having abs(sst1231 – gfssst) > 5 K |
| cnt_d_sst1231_gfs_gt_10 | 2 | int-16 | None | Count of footprints having abs(sst1231 – gfssst) > 10 K |
| cnt_d_sst1231_gfs_gt_20 | 2 | int-16 | None | Count of footprints having abs(sst1231 – gfssst) > 20 K |
| cnt_d_sst1231_gfs_gt_30 | 2 | int-16 | None | Count of footprints having |

| | | | | |
|---|---|---|---|---|
| | | | | abs(sst1231 – gfssst) > 30 K |
| cnt_d_sst1231_gfs_gt_40 | 2 | int-16 | None | Count of footprints having abs(sst1231 – gfssst) > 40 K |
| cnt_d_sst1231_gfs_gt_50 | 2 | int-16 | None | Count of footprints having abs(sst1231 – gfssst) > 50 K |
| cnt_d_sst1231_gfs_gt_60 | 2 | int-16 | None | Count of footprints having abs(sst1231 – gfssst) > 60 K |
| cnt_d_sst1231_gfs_gt_70 | 2 | int-16 | None | Count of footprints having abs(sst1231 – gfssst) > 70 K |
| cnt_d_sst1231_gfs_gt_80 | 2 | int-16 | None | Count of footprints having abs(sst1231 – gfssst) > 80 K |
| cnt_d_sst1231_gfs_gt_90 | 2 | int-16 | None | Count of footprints having abs(sst1231 – gfssst) > 90 K |
| amsu_bt_mean | 2 | float-32 | AMSU_ Channel (15) | mean brightness temperature [K] for each AMSU-A channel |
| cnt_sun_glint | 2 | int-16 | None | Count of footprints < 200 km distant from sun glint, which are valid (state = “process”) and have a maximum VIS Channel 3 radiance > 3000 |
| CalChanSummary | 1 | uint-8 | IR_ Channel (2378) | Summary of calibration related occurrences for each IR channel in this granule, as detailed by the following flags:<br>Bit 7 (MSB): scene over/underflow;<br>Bit 6: (value 64) anomaly in offset calculation;<br>Bit 5: (value 32) anomaly in gain calculation;<br>Bit 4: (value 16) pop detected;<br>Bit 3: (value 8) noise out of bounds;<br>Bit 2: (value 4) anomaly in spectral calibration;<br>Bit 1: (value 2) Telemetry;<br>Bit 0: (LSB, value 1) unused (reserved);<br>If all flags are zero the channel was well calibrated for all scanlines |
| NeN | 1 | float-32 | IR_ Channel (2378) | Noise-equivalent Radiances at 250K. Given in units of mW / $m^2$ / $cm^{-1}$ / steradian |

# Appendix A4. Level 3 Standard Product Interface Specification

Interface Specification Version 6.0.8.0
2012-10-18

ESDT ShortNames=
"AIRX3STD", "AIRX3ST8", "AIRX3STM",
"AIRH3STD", "AIRH3ST8", "AIRH3STM",
"AIRS3STD", "AIRS3ST8", "AIRS3STM"

DOIs =

"10.5067/AQUA/AIRS/DATA301", "10.5067/AQUA/AIRS/DATA310",
"10.5067/AQUA/AIRS/DATA319",

"10.5067/AQUA/AIRS/DATA302", "10.5067/AQUA/AIRS/DATA311",
"10.5067/AQUA/AIRS/DATA320",

"10.5067/AQUA/AIRS/DATA303", "10.5067/AQUA/AIRS/DATA312",
"10.5067/AQUA/AIRS/DATA321"

Grid Names = "location", "ascending", "descending", "ascending_TqJoint",
"descending_TqJoint", "ascending_MW_only", "descending_MW_only"

Horizontal resolution= 1°x1° degree (360x180)

Upper Left Point= -180.0, 90.0

Lower Right Point= 180.0, -90.0

Projection= GCTP_GEO (Global image)

## Temporal Characteristics of AIRS Level 3 Products

The temporal resolution of the AIRS Level 3 Standard products is daily, 8-day (half of the 16 day Aqua orbit repeat cycle) and monthly based on the needs of different user communities.

Daily Level 3 products are intended to address the needs of the Numerical Weather Prediction (NWP) and numerical modeling community. This community is interested in temperature, specific humidity, and geopotential height profiles, cloud thickness, height and fraction, surface moisture and emissivity. In addition, individual users can easily aggregate daily Level 3 products into custom multi-day global products based on their specific needs. These data are also used as input to the 8-day and monthly Level 3 products.
Level 3 products with a temporal resolution of 8-days address the needs of researchers interested in climate quasi-oscillations and assorted phenomena, such as the Madden-Julian Oscillation, annular modes, etc.

The monthly Level 3 products address the interests of those involved in climate trend analysis. They are typically interested in monthly means over long timescales and prefer data products with the lowest possible systematic errors. The characteristics of these three data types are summarized in Table 1.

Users of AIRS Level 3 products should be aware that the temporal span of Level 3 daily files is not midnight-to-midnight. The data proceeds in time from left (-180.0°) to right (180.0°) with neighboring cells of data no more than a swath of time apart. This ensures that data points in a grid box are always coincident in time, if the data were gridded using a midnight-to-midnight time scheme, the start of the day and the end of the day would be in the same grid cell, producing an artificial time discontinuity across the grid. The edges of the AIRS Level 3 cells are at the date line (the 180E/W longitude boundary). When plotted, this produces a map with 0 degrees longitude in the center of the image. This method is preferred because the left side of the grid and the right side of the grid contain data farthest apart in time. The method used is analogous to that used to create TOVS Pathfinder level 3 products.

| **L3 Standard Product Characteristics** | | |
|---|---|---|
| ***Daily*** | ***8-Day*** | ***Monthly*** |
| "Complex" data, leaves in gores between satellite tracks (missing) | "Moderate" data, no gores, and some data dropouts. | "Simple" data, no gores, complete coverage |
| 1°x1° spatial resolution | 1°x1° spatial resolution | 1°x1° spatial resolution |
| 1-day temporal resolution. | 8-day temporal resolution based on Aqua 16-day repeat cycle. | Monthly (calendar) |

## Level-3 Standard Product Grids

The data in the Level-3 standard product is contained in 7 HDF-EOS Grids. Each grid includes datat for the entire globe in 360 x 180 grid cells each 1 x 1 degree of latitude/longitude. Most fields appear in the 4 main grids: ascending, descending, ascending_TqJoint, and descending_TqJoint. The ascending grids collect data taken while the spacecraft is in the ascending part of its orbit. This is generally daytime, except near the poles.

For the ascending and descending grids (and ascending_MW_Only and descending_MW_Ony), Level-2 quality control per field is used (*_QC) collecting all observations where quality level is 0 (best) or 1 (good). This ensures that these grids have the most complete set of data available for each field and level, but the use of different ensembles for different data fields can complicate comparisons across fields or levels, so the TqJoint fields apply a single, unified quality control criterion for all fields: TSurfAir_QC must be 0 or 1. Analyses which depend upon correlations between temperature and water vapor fields or correlations of temperature or water vapor between different pressure levels should always use TqJoint grids that contain data for a common set of observations across water vapor and temperature at all atmospheric levels.

| Grid name | Tag | Description |
|---|---|---|
| location | None | Location information which is valid for all grids |
| ascending | _A | Information collected while the spacecraft is in the ascending part of its orbit. (Daytime data except near the poles.) Each field and level is individually quality controlled. |
| descending | _D | Information collected while the spacecraft is in the descending part of its orbit. (Nighttime data except near the poles.) Each field and level is individually quality controlled. |
| ascending_TqJoint | _TqJ_A | Information collected while the spacecraft is in the ascending part of its orbit. (Daytime data except near the poles.) Collective quality control is used across all fields and levels. |
| descending_TqJoint | _TqJ_D | Information collected while the spacecraft is in the descending part of its orbit. (Nighttime data except near the poles.) Collective quality control is used across all fields and levels. |
| ascending_MW_Only | _MW_A | Microwave information collected while the spacecraft is in the ascending part of its orbit. (Daytime data except near the poles.) |
| descending_MW_Only | _MW_D | Microwave information collected while the spacecraft is in the descending part of its orbit. (Nighttime data except near the poles.) |

## Geolocation Fields

These fields are within the location grid and document pertinent information for determining the location and characteristics of a given grid cell for all grids.

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| Latitude | 32-bit floating-point | None | Array of 360 x 180 latitude values at the center of the grid box (Degrees). |
| Longitude | 32-bit floating-point | None | Array of 360 x 180 longitude values at the center of the grid box (Degrees). |
| LandSeaMask | 16-bit integer | None | Land sea mask. 1 = land, 0 = ocean. (Unitless). (Up through v5 this data was used to exclude land profiles from grid squares marked sean and vice versa. As of v6 this is not done, but the field is retained for user convenience.) |
| Topography | 32-bit floating-point | None | Topography of the Earth in meters above the geoid. Original data source: PGS Toolkit |

## Attributes

These fields appear once per Level 3 file as HDF-EOS grid attributes in the location grid. They apply to the entire file.

The attributes with extra dimensions are provided in this format for backwards compatibility, but the same information is provided in identically named dimensions with associated dimension scales in the grids where these dimensions are used.

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| Year | 32-bit integer | None | Year at start of nominal data period |
| Month | 32-bit integer | None | Month at start of nominal data period [1,12] |
| Day | 2-bit integer | None | Day of month at start of nominal data period [1,31] |
| NumOfDays | 32-bit integer | None | Total number of days of input Level 2 data included in |

| | | | |
|---|---|---|---|
| | | | gridded maps. |
| AscendingGridStartTimeUTC | String of 8-bit characters | None | Begin time of mappe fields (UTC), ascending. |
| AscendingGridEndTimeUTC | String of 8-bit characters | None | End time of mapped fields (UTC), ascending. |
| DescendingGridStartTimeUTC | String of 8-bit characters | None | Begin time of mapped fields (UTC), descending. |
| DescendingGridEndTimeUTC | String of 8-bit characters | None | End time of mapped fields (UTC), descending. |
| StdPressureLev | 32-bit floating point | StdPressureLev (24) | Pressure levels of temperature profiles and geopotential height. The array order is from the surface upward, in conformance with WMO standard. Note that the Level-3 pressure levels are a subset of Level-2 pressure levels and are constrained to begin at 1000.0 mb and end at 1.0 mb. |
| H2OPressureLev | 32-bit floating point | H2OPressureLev (12) | Pressure levels of water vapor level profiles. |
| H2OPressureLay | 32-bit floating point | H2OPressureLay (12) | Midpoints of pressure layers of water vapor layer profiles. |
| EmisFreqIR | 32-bit floating point | EmisFreqIR (4) | Frequencies corresponding to each of the 4 IR emissivity values reported in the AIRS Level 3 Standard Product. (832.0, 961.0, 1203.0, 2616.0 cm-1) |
| EmisFreqMW | 32-bit floating point | EmisFreqMW (3) | Frequencies corresponding to each of the 3 microwave emissivity values reported in the AIRS Level 3 |

| | | | |
|---|---|---|---|
| | | | Standard Product. (23.0, 50.3, and 89.0 GHz) |
| CoarseCloudLayer | 32-bit floating point | CoarseCloudLayer (3) | Midlayer pressures of the 3 coarse cloud layers |
| FineCloudLayer | 32-bit floating point | FineCloudLayer (12) | Midlayer pressures of the 12 fine cloud layers |

## Grid Dimensions

These dimensions appear in selected grids as needed.

| Name | Grids | Size: Values | Explanation |
|---|---|---|---|
| StdPressureLev | ascending, descending, ascending_TqJoint, descending_TqJoint, ascending_MW_Only, descending_MW_Only | 24: 1000, 925, 850, 700, 600, 500, 400, 300, 250, 200, 150, 100, 70, 50, 30, 20, 15, 10, 7, 5, 3, 2, 1.5, 1 hPa | Pressure levels of temperature and trace gas profiles and geopotential height. The array order is from the surface upward, in conformance with WMO standard. Note that the Level-3 pressure levels are a subset of the 28 Level-2 pressure levels, restricted to the range of [1.0, 1000.0] hPa. |
| H2OPressureLev | ascending, descending, ascending_TqJoint, descending_TqJoint | 12: 1000, 925, 850, 700, 600, 500, 400, 300, 250, 200, 150, 100 hPa | Pressure levels of water vapor level profiles. |
| H2OPressureLay | ascending, descending, ascending_TqJoint, descending_TqJoint | 12: 961.8, 886.7 771.4, 648.1, 547.7, 447.2, 346.4, 273.9, 223.6, 173.2, 122.5, 83.7 hPa | Midpoints of pressure layers of water vapor layer profiles. Layer boundaries are at StdPressureLev. |
| EmisFreqIR | ascending, descending, ascending_TqJoint, descending_TqJoint | 4: 832, 961, 1203, 2616 $cm^{-1}$ | Frequencies corresponding to each of the 4 IR emissivity values reported in the AIRS Level 3 Standard Product. |
| EmisFreqMW | ascending_MW_Only, descending_MW_Only | 3: 23.0, 50.3, 89.0 GHz | Frequencies corresponding to each of the 3 microwave emissivity values reported in the AIRS Level 3 Standard Product. |
| CoarseCloudLayer | ascending, | 3: | Midlayer pressures of the 3 |

| | | | |
|---|---|---|---|
| | descending,<br>ascending_TqJoint,<br>descending_TqJoint | 865., 547., 66.<br>hPa | coarse cloud layers. Layer boundaries are at {1100., 680., 440., 10.} hPa |
| FineCloudLayer | ascending,<br>descending,<br>ascending_TqJoint,<br>descending_TqJoint | 12:<br>1018, 887, 771, 648, 548, 447, 346, 274, 224, 173, 122, 32 hPa | Midlayer pressures of the 24 fine cloud layers. Layer boundaries are at {1100., 925., 850., 700., 600, 500, 400, 300, 250, 200, 150, 100, 10} hPa |
| XDim | location,<br>ascending,<br>descending,<br>ascending_TqJoint,<br>descending_TqJoint,<br>ascending_MW_Only,<br>descending_MW_Only | 360:<br>-179.5, -178.5, … 178.5, 179.5 | West to East dimension for all grids. Long_name "Longitude". Values are mid-cell longitude. |
| YDim | location,<br>ascending,<br>descending,<br>ascending_TqJoint,<br>descending_TqJoint,<br>ascending_MW_Only,<br>descending_MW_Only | 180:<br>-89.5, -88.5, … 88.5, 89.5 | South to North dimension for all grids. Long_name "Latitude". Values are mid-cell latitude. |

## Grid Fields in Grids ascending, descending, ascending_TqJoint, and descending_TqJoint

These fields appear once per grid. Tags from the grid table are appended so that the final field names are unique across all the grids in each file. For example the field with the basename "Temperature" will appear as "Temperature_A" in the ascending grid and "Temperature_TqJ_D" in the descending_TqJoint grid. The value in the main field is the mean over all observations which fell in the grid cell and passed quality control. Quantities for which Level-2 provides just one retrieved value per FOR (3x3 AIRS FOVs) are recorded for each of the 9 AIRS FOV center locations.

There are also up to 5 ancillary fields for each field:

1. _ct is a 16-bit count of the number of observations used in the calculation. It can be ratioed with TotalCounts to give a yield. It is present for all floating-point fields.
2. _sdev is a 32-bit standard deviation over the observations in this grid cell. It is present for all floating-point fields.
3. _min is the 32-bit floating-point minimum of the observations in this grid cell. It is present for all floating-point fields.

4. _max is the 32-bit floating-point maximum of the observations in this grid cell. It is present for all floating-point fields.
5. _err is the 32-bit floating-point mean of the Level-2 error estimates of the observations in this grid cell. It is present for all fields where the Level-2 product provides an error estimate.

So for example in the ascending_TqJoint grid the main (mean) Temperature field is "Temperature_TqJ_A" and it has ancillary fields "Temperature_TqJ_A_ct", "Temperature_TqJ_A_sdev", "Temperature_TqJ_A_min", "Temperature_TqJ_A_max", and "Temperature_TqJ_A_err".

| Basename | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| TotalCounts | 16-bit integer | None | Total counts of all points that fell within a 1°x1° grid cell whether they were included in the final L3 product or not. Used for yield calculations. |
| SurfPres_Forecast | 32-bit floating point | None | Surface pressure from forecast. (hPa) |
| SurfSkinTemp | 32-bit floating point | None | Surface skin temperature. (Kelvin) |
| EmisIR | 32-bit floating point | EmisFreqIR (4) | IR surface emissivity at frequencies {832, 961, 1203, 2616} $cm^{-1}$ |
| Temperature | 32-bit floating point | StdPressureLev (24) | Atmospheric temperature (Kelvin) |
| SurfAirTemp | 32-bit floating point | None | Temperature of the atmosphere at the Earth's surface. (Kelvin) |
| TropPres | 32-bit floating point | None | Pressure of the tropopause. (hPa) |
| TropTemp | 32-bit floating point | None | Temperature of the tropopause. (Kelvin) |
| TotH2OVap | 32-bit floating point | None | Total integrated column water vapor burden. ($kg/m^2$) |
| H2O_MMR_Lyr | 32-bit floating point | H2OPressureLay (12) | Water vapor mass mixing ratio averaged over each of standard pressure layers (gm/kg dry air) |
| H2O_MMR | 32-bit floating point | H2OPressureLev (12) | Water vapor mass mixing ratio at standard pressure levels (gm/kg dry air) |
| H2O_MMR_Surf | 32-bit floating point | None | Water vapor mass mixing ratio at the surface (gm/kg dry air) |
| RelHum | 32-bit | H2OPressureLev | Relative humidity over |

| | | | |
|---|---|---|---|
| | floating point | (12) | equilibrium phase (Percent) |
| RelHumSurf | 32-bit floating point | None | Relative humidity at the surface over equilibrium phase (Percent) |
| RelHum_liquid | 32-bit floating point | H2OPressureLev (12) | Relative humidity over liquid phase (Percent) |
| RelHumSurf_liquid | 32-bit floating point | None | Relative humidity at the surface over liquid phase (Percent) |
| TropHeight | 32-bit floating point | None | Height of the tropopause. (meters) |
| GPHeight | 32-bit floating point | StdPressureLev (24) | Geopotential height. (Meters) |
| CloudFrc | 32-bit floating point | None | Combined layer cloud fraction. (0-1). (Unitless) |
| CloudTopPres | 32-bit floating point | None | Combined cloud top pressure (weighted by cloud fraction). (hPa) |
| CloudTopTemp | 32-bit floating point | None | Combined cloud top temperature (weighted by cloud fraction). (Kelvin) |
| FineCloudFrc | 32-bit floating point | FineCloudLayer (12) | Cloud fraction at fine cloud resolution (Unitless) |
| CoarseCloudFrc | 32-bit floating point | CoarseCloudLayer (3) | Cloud fraction at coarse cloud resolution. 3 layers: low, middle, high. (Unitless) |
| CoarseCloudPres | 32-bit floating point | CoarseCloudLayer (3) | Cloud layer pressure at coarse cloud resolution. 3 layers: low, middle, high. (hPa) |
| CoarseCloudTemp | 32-bit floating point | CoarseCloudLayer (3) | Cloud layer cloud top temperature at coarse cloud resolution. 3 layers: low, middle, high. (Kelvin) |
| TotO3 | 32-bit floating point | None | Total integrated column ozone burden. (Dobson units) |
| O3_VMR | 32-bit floating point | StdPressureLev (24) | Ozone volume mixing ratio (ppv) |
| TotCO | 32-bit floating point | None | Retrieved total column CO. (molecules/$cm^2$) |
| CO_VMR | 32-bit floating point | StdPressureLev (24) | CO volume mixing ratio. (ppv) |
| TotCH4 | 32-bit floating point | None | Retrieved total column CH4. (molecules/$cm^2$) |
| CH4_VMR | 32-bit floating point | StdPressureLev (24) | CH4 volume mixing ratio. (ppv) |
| OLR | 32-bit floating point | None | Outgoing long-wave radiation flux. (watts/$m^2$) |

| | | | |
|---|---|---|---|
| ClrOLR | 32-bit floating point | None | Clear-sky outgoing long-wave radiation flux. (watts/$m^2$) |

## Microwave-only Ascending and Descending Grid Fields

These fields appear once per grid. Tags from the grid table are appended so that the final field names are unique across all the grids in each file. For example the field with the basename "Temperature" will appear as "Temperature_MW_A" in the ascending_MW_Only grid. The value in the main field is the mean over all observations which fell in the grid cell and passed quality control. Quantities for which Level-2 provides just one retrieved value per FOR (3x3 AIRS FOVs) are recorded for each of the 9 AIRS FOV center locations.

There are also up to 5 ancillary fields for each field:

1. _ct is a 16-bit count of the number of observations used in the calculation. It can be ratioed with TotalCounts to give a yield. It is present for all floating-point fields.
2. _sdev is a 32-bit standard deviation over the observations in this grid cell. It is present for all floating-point fields.
3. _min is the 32-bit floating-point minimum of the observations in this grid cell. It is present for all floating-point fields.
4. _max is the 32-bit floating-point maximum of the observations in this grid cell. It is present for all floating-point fields.
5. _err is the 32-bit floating-point mean of the Level-2 error estimates of the observations in this grid cell. It is present for all fields where the Level-2 product provides an error estimate.

So for example in the ascending_MW_Only grid the main (mean) Temperature field is "Temperature_MW_A" and it has ancillary fields "Temperature_MW_A_ct", "Temperature_MW_A_sdev", "Temperature_MW_A_min", "Temperature_MW_A_max", and "Temperature_MW_A_err".

| Basename | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| TotalCounts | 16-bit integer | None | Total counts of all points that fell within a 1°x1° grid cell whether they were included in the final L3 product or not. Used for yield calculations. |
| Emis | 32-bit floating point | EmisFreqMW (3) | Microwave spectral emissivity at frequencies {23.8, 50.3 and 89.0} GHz. |
| Temperature | 32-bit floating | StdPressureLev (24) | Microwave-only atmospheric temperature (Kelvin) |

| | | | |
|---|---|---|---|
| | point | | |
| TotH2OVap | 32-bit floating point | None | Total integrated column water vapor burden. ($kg/m^2$) |
| GPHeight | 32-bit floating point | 2 StdPressureLev (24)4 | Microwave-only geopotential height (Meters) |
| TotCldLiqH2O | 32-bit floating point | None | Total integrated column cloud liquid water. ($kg/m^2$) |

# Appendix A5. Level 3 Support Product Interface Specification

Interface Specification Version 6.0.8.0
2012-10-18

ESDT ShortNames=
"AIRX3SPD", "AIRX3SP8", "AIRX3SPM",
"AIRH3SPD", "AIRH3SP8", "AIRH3SPM",
"AIRS3SPD", "AIRS3SP8", "AIRS3SPM"

DOIs =

"10.5067/AQUA/AIRS/DATA304", "10.5067/AQUA/AIRS/DATA313",
"10.5067/AQUA/AIRS/DATA322",

"10.5067/AQUA/AIRS/DATA305", "10.5067/AQUA/AIRS/DATA315",
"10.5067/AQUA/AIRS/DATA323",

"10.5067/AQUA/AIRS/DATA306", "10.5067/AQUA/AIRS/DATA315",
"10.5067/AQUA/AIRS/DATA324"

Grid Names = "location", "ascending", "descending"

Horizontal resolution= 1°x1° degree (360x180)

Upper Left Point= -180.0, 90.0

Lower Right Point= 180.0, -90.0

Projection= GCTP_GEO (Global image)

The L3 support products are similar to the L3 standard products but contain fields which are not fully validated, or are inputs or intermediary values. Because no quality control information is available for some of these fields, values from failed retrievals may be included.

## Temporal Characteristics of AIRS Level 3 Products

The temporal resolution of the AIRS Level 3 Support products is daily, 8-day (half of the 16 day Aqua orbit repeat cycle) and monthly based on the needs of different user communities.

Daily Level 3 products are intended to address the needs of the Numerical Weather Prediction (NWP) and numerical modeling community. This community is interested in temperature, specific humidity, and geopotential height profiles, cloud thickness, height and fraction, surface moisture and emissivity. In addition, individual users can easily aggregate daily Level 3 products into custom multi-day global products based on their specific needs. These data are also used as input to the 8-day and monthly Level 3 products.
Level 3 products with a temporal resolution of 8-days address the needs of researchers interested in climate quasi-oscillations and assorted phenomena, such as the Madden-Julian Oscillation, annular modes, etc.

The monthly Level 3 products address the interests of those involved in climate trend analysis. They are typically interested in monthly means over long timescales and prefer data products with the lowest possible systematic errors. The characteristics of these three data types are summarized in Table 1.

Users of AIRS Level 3 products should be aware that the temporal span of Level 3 daily files is not midnight-to-midnight. The data proceeds in time from left (-180.0°) to right (180.0°) with neighboring cells of data no more than a swath of time apart. This ensures that data points in a grid box are always coincident in time, if the data were gridded using a midnight-to-midnight time scheme, the start of the day and the end of the day would be in the same grid cell, producing an artificial time discontinuity across the grid. The edges of the AIRS Level 3 cells are at the date line (the 180E/W longitude boundary). When plotted, this produces a map with 0 degrees longitude in the center of the image. This method is preferred because the left side of the grid and the right side of the grid contain data farthest apart in time. The method used analogous to that used to create TOVS Pathfinder level 3 products.

| **L3 Product Characteristics** | | |
|---|---|---|
| ***Daily*** | ***8-Day*** | ***Monthly*** |
| "Complex" data, leaves in gores between satellite tracks (missing) | "Moderate" data, no gores, and some data dropouts. | "Simple" data, no gores, complete coverage |
| 1°x1° spatial resolution | 1°x1° spatial resolution | 1°x1° spatial resolution |
| 1-day temporal resolution. | 8-day temporal resolution based on Aqua 16-day repeat cycle. | Monthly (calendar) |

## Level-3 Support Product Grids

The data in the Level-3 support product is contained in 3 HDF-EOS Grids. Each grid includes datat for the entire globe in 360 x 180 grid cells each 1 x 1 degree of latitude/longitude. Most fields appear in the 2 main grids: ascending and descending. The ascending grids collect data taken while the spacecraft is in the ascending part of its orbit. This is generally daytime, except near the poles.

| Grid name | Tag | Description |
|---|---|---|
| location | None | Location information which is valid for all grids |
| ascending | _A | Information collected while the spacecraft is in the ascending part of its orbit. (Daytime data except near the poles.) |
| descending | _D | Information collected while the spacecraft is in the descending part of its orbit. (Nighttime data except near the poles.) |

## Geolocation Fields

These fields are within the location grid and document pertinent information for determining the location and characteristics of a given grid cell for all grids.

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| Latitude | 32-bit floating-point | None | Array of 360 x 180 latitude values at the center of the grid box (Degrees). |
| Longitude | 32-bit floating-point | None | Array of 360 x 180 longitude values at the center of the grid box (Degrees). |
| LandSeaMask | 16-bit integer | None | Land sea mask. 1 = land, 0 = ocean. (Unitless). (Up through v5 this data was used to exclude land profiles from grid squares marked sean and vice versa. As of v6 this is not done, but the field is retained for user convenience.) |
| Topography | 32-bit floating-point | None | Topography of the Earth in meters above the geoid. Original data source: PGS Toolkit |

## Attributes

These fields appear once per Level 3 file as HDF-EOS grid attributes in the location grid. They apply to the entire file.

The attributes with extra dimensions are provided in this format for backwards compatibility, but the same information is provided in identically named dimensions with associated dimension scales in the grids where these dimensions are used.

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| Year | 32-bit integer | None | Year at start of nominal data period |
| Month | 32-bit integer | None | Month at start of nominal data period [1,12] |
| Day | 2-bit integer | None | Day of month at start of nominal data period [1,31] |
| NumOfDays | 32-bit integer | None | Total number of days of input Level 2 data included in gridded maps. |
| AscendingGridStartTimeUTC | String of 8-bit characters | None | Begin time of mapped fields (UTC), ascending. |
| AscendingGridEndTimeUTC | String of 8-bit characters | None | End time of mapped fields (UTC), ascending. |
| DescendingGridStartTimeUTC | String of 8-bit characters | None | Begin time of mapped fields (UTC), descending. |
| DescendingGridEndTimeUTC | String of 8-bit characters | None | End time of mapped fields (UTC), descending. |
| SurfClass | 32-bit integer | SurfClass (7) | Surface Classes counted in SurfClass_Count |
| DustTest | 32-bit integer | DustTest (9) | Dust Tests counted in Dust_Score |
| SpectralOLR | 32-bit integer | SpectralOLR (16) | Frequency bands on which spectralolr and spectralclrolr are reported |
| CloudPhase | 32-bit integer | CloudPhase (4) | Cloud phases used in cloud_phase_3x3 |
| SpectralClr | 32-bit | SpectralClr (5) | Categories used in |

| | | | |
|---|---|---|---|
| | integer | | Spectral_Clear_Counts |
| MODISEmis10Hinge | 32-bit integer | MODISEmis10Hinge (10) | 10 MODIS emissivity hinge points |
| XtraPressureLev | 32-bit integer | XtraPressureLev (100) | 100 pressure levels for internal temperature profiles |
| XtraPressureLay | 32-bit integer | XtraPressureLay (100) | 100 pressure layer for internal gas profiles |

## Grid Dimensions

These dimensions appear in selected grids as needed.

| Name | Grids | Size: Values | Explanation |
|---|---|---|---|
| XtraPressureLev | ascending, descending | 100 | Pressure levels of internal 100-level temperature profiles. hPa. |
| XtraPressureLay | ascending, descending | 100 | Pressure layers of internal 100-layer gas profiles. hPa. |
| SurfClass | ascending, descending | 7: "coastline (Liquid water covers 50-99% of area)", "land (Liquid water covers < 50% of area)", "ocean (Liquid water covers > 99% of area)", "sea ice (High MW emissivity)", "sea ice (Low MW emissivity)", "snow (Higher-frequency MW scattering)", "glacier/snow (Very low-frequency MW scattering)", "snow (Lower-frequency MW scattering)" | Surface Classes counted in SurfClass_Count |
| DustTest | ascending, descending | 9: | Dust Tests counted in Dust_Score. Least significant to most significant. |
| MODISEmis10Hinge | ascending, descending | 10: 699.30, 826.45, 925.93, 1075.27 1204.82, 1315.79, 1724.14, 2000.00, 2325.58, 2777.78 | MODIS emissivity hinge points |
| SpectralOLR | ascending, descending | 16: | Frequency bands on which spectralolr and spectralclrolr are reported |

| | | | |
|---|---|---|---|
| CloudPhase | ascending, descending | 7:<br>liquid (high confidence),<br>liquid (low confidence),<br>unknown,<br>ice (low confidence),<br>ice (medium confidence),<br>ice (high confidence), ice (very high confidence) | Cloud phases used in cloud_phase_3x3 |
| SpectralClr | ascending, descending | 5:<br>"Ocean test applied and scene identified as clear",<br>"Ocean test applied and scene not identified as clear",<br>"Calculation could not be completed. Possibly some inputs were missing or FOV is on coast or on the edge of a scan or granule",<br>"Unvalidated land test applied and scene not identified as clear",<br>"Unvalidated land test applied and scene identified as clear"<br>: | Categories used in Spectral_Clear_Counts |
| XDim | location, ascending, descending | 360:<br>-179.5, -178.5, … 178.5, 179.5 | West to East dimension for all grids. Long_name "Longitude". Values are mid-cell longitude. |
| YDim | location, ascending, descending | 180:<br>-89.5, -88.5, … 88.5, 89.5 | South to North dimension for all grids. Long_name "Latitude". Values are mid-cell latitude. |

## Grid Fields in Grids ascending and descending

These fields appear once per grid. Tags from the grid table are appended so that the final field names are unique across all the grids in each file. For example the field with the basename "COCDSup" will appear as "COCDSup_A" in the ascending grid and "COCDSup_D" in the descending grid. The value in the main field is the mean over all observations which fell in the grid cell and passed quality control. Quantities for which Level-2 provides just one retrieved value per FOR (3x3 AIRS FOVs) are recorded for each of the 9 AIRS FOV center locations.

There are also up to 5 ancillary fields for each field:

6. _ct is a 16-bit count of the number of observations used in the calculation. It can be ratioed with TotalCounts to give a yield. It is present for all floating-point fields.
7. _sdev is a 32-bit standard deviation over the observations in this grid cell. It is present for all floating-point fields.
8. _min is the 32-bit floating-point minimum of the observations in this grid cell. It is present for all floating-point fields.
9. _max is the 32-bit floating-point maximum of the observations in this grid cell. It is present for all floating-point fields.
10. _err is the 32-bit floating-point mean of the Level-2 error estimates of the observations in this grid cell. It is present for all fields where the Level-2 product provides an error estimate.

So for example in the ascending grid the main (mean) COCDSup field is "COCDSup_A" and it has ancillary fields "COCDSup_A_ct", "COCDSup_A_sdev", "COCDSup_A_min", "COCDSup_A_max", and "COCDSup_A_err".

| Basename | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| TotalCounts | 16-bit integer | None | Total counts of all points that fell within a 1°x1° grid cell whether they were included in the final L3 product or not. Used for yield calculations. |
| Dust_Score | 32-bit floating point | DustTest (9) | Fraction of obs with each dust test triggered. [0.0, 1.0] |
| SO2_Indicator | 32-bit floating point | None | Brightness temperature difference Tb(1361.44 cm-1) - Tb(1433.06 cm-1) used as an indicator of SO2 release from volcanoes. Values under -6 K have likely volcanic SO2. (level-2 BT_diff_SO2) (Kelvins) |
| TAirSup | 32-bit floating point | XtraPressureLev (100) | Atmospheric temperature (Kelvin) |
| Temp_dof | 32-bit floating point | None | Degrees of freedom from the physical retrieval of temperature (unitless) |
| H2OCDSup | 32-bit floating point | XtraPressureLay (100) | Water vapor layer column density (molecules/$cm^2$) |
| H2O_dof | 32-bit floating point | None | Degrees of freedom from the physical retrieval of water vapor (unitless) |

| | | | |
|---|---|---|---|
| bndry_lyr_top | 32-bit floating point | None | Pressure at top of planetary boundary layer (hPa) |
| cloud_phase_3x3 | 32-bit floating point | CloudPhase (7) | Counts of observations with each of the 7 possible cloud phase values. Use with TotalCounts to get fraction of obs with any given type. |
| ice_cld_opt_dpth | 32-bit floating point | None | Ice cloud optical depth (unitless) |
| ice_cld_opt_dpth | 32-bit floating point | None | Ice cloud optical depth (unitless) |
| ice_cld_eff_diam | 32-bit floating point | None | Ice cloud effective diameter (microns) |
| ice_cld_temp_eff | 32-bit floating point | None | Ice cloud effective cloud top temperature (Kelvin) |
| ice_cld_fit_reduced_chisq | 32-bit floating point | None | Normalized chi-square residual of the obs-calc radiance residual in the ice cloud optical properties calculation |
| O3CDSup | 32-bit floating point | XtraPressureLay (100) | Ozone layer column density (molecules/$cm^2$) |
| O3_VMR_Surf | 32-bit floating point | None | Ozone volume mixing ratio at the surface (ppmv) |
| O3_dof | 32-bit floating point | None | Degrees of freedom from the physical retrieval of ozone (unitless) |
| COCDSup | 32-bit floating point | XtraPressureLay (100) | Carbon monoxide layer column density (molecules/$cm^2$) |
| CO_VMR_Surf | 32-bit floating point | None | Carbon monoxide volume mixing ratio at the surface (ppmv) |
| CO_dof | 32-bit floating point | None | Degrees of freedom from the physical retrieval of carbon monoxide (unitless) |
| CH4CDSup | 32-bit floating point | XtraPressureLay (100) | Methane layer column density (molecules/$cm^2$) |
| CH4_VMR_Surf | 32-bit floating point | None | Methane volume mixing ratio at the surface (ppmv) |
| CH4_dof | 32-bit | None | Degrees of freedom from the |

| | | | |
|---|---|---|---|
| | floating point | | physical retrieval of methane (unitless) |
| spectralolr | 32-bit floating point | SpectralOLR (16) | Outgoing longwave radiation flux integrated over 16 frequancy bands (Watts/meter$^2$) |
| spectralclrolr | 32-bit floating point | SpectralOLR (16) | Clear-sky Outgoing longwave radiation flux integrated over 16 frequancy bands (Watts/meter$^2$) |
| SurfClass_Count | 16-bit integer | SurfClass (7) | Count of cases with each surface type. |
| IR_Precip_Est | 32-bit floating point | None | Regression-based estimate of daily precipitation based on clouds and relative humidity from Level 2 IR/MW retrieval. Analogous to and forms a continuous record when used with TOVS precipitation index. (per 45 km AMSU-A FOV) (mm/day) |
| MWSST | 32-bit floating point | None | Effective surface skin temperature from MW-Only retrieval step. BT / emis @ 23.8 GHz. (Kelvin) |
| MW_Emis_24GHz | 32-bit floating point | None | MW emissivity @ 23.8 GHz (unitless) |
| MW_Emis_31GHz | 32-bit floating point | None | MW emissivity @ 31.4 GHz (unitless) |
| MW_Emis_50GHz | 32-bit floating point | None | MW emissivity @ 50.3 GHz (unitless) |
| MW_Emis_89GHz | 32-bit floating point | None | MW emissivity @ 89.0 GHz (unitless) |
| SurfSkinTemp_Forecast | 32-bit floating point | None | Predicted surface temperature interpolated from NOAA NCEP GFS forecast (K) |
| MODIS_LST | 32-bit floating point | None | First guess climatology land surface temperature from MODIS averaged over MYD11C3 0.05 degree (~5 km) pixels covering an area roughly corresponding to an AMSU FOV or 3x3 of AIRS FOVs. |
| MODIS_emis_10_hinge | 32-bit | MODISEmis10Hinge (= | First guess emissivity from |

| | | | |
|---|---|---|---|
| | floating-point | 10) | MODIS (MODIS_emis) expanded to 10 hinge points |
| Strato_CCI | 32-bit floating-point | None | A Stratospheric Coarse Climate Indicator representing the weighted average of retrieved temperatures over the lower stratosphere (maximum weight near 70 hPa). The weighting is done in such a manner as to make the weighted temperatures roughly correspond to those given by the MSU4 products in the Spencer and Christy temperature data set, as well as in the TOVS Pathfinder Path A data set (K) |
| Tropo_CCI | 32-bit floating-point | None | A Tropospheric Coarse Climate Indicator representing the weighted average of retrieved temperatures over the lower troposphere (maximum weight near 700 hPa). The weighting is done in such a manner as to make the weighted temperatures roughly correspond to those given by the MSU2R products in the Spencer and Christy temperature data set, as well as in the TOVS Pathfinder Path A data set (K) |
| Spectral_Clear_Counts | 16-bit integer | SpectralClr (=5) | Counts of cases found for each value of spectral_clear_indicator |

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# Appendix A6. Level 3 Research Product Interface Specification

Interface Specification Version 6.0.8.0
2012-10-18

ESDT ShortNames=
“AIRX3RED”, “AIRX3RE8”, “AIRX3SREM”,
“AIRH3RED”, “AIRH3RE8”, “AIRH3REM”,
“AIRS3RED”, “AIRS3RE8”, “AIRS3REM”

DOIs =

“10.5067/AQUA/AIRS/DATA307”, “10.5067/AQUA/AIRS/DATA316”,
“10.5067/AQUA/AIRS/DATA325”,

“10.5067/AQUA/AIRS/DATA308”, “10.5067/AQUA/AIRS/DATA317”,
“10.5067/AQUA/AIRS/DATA326”,

“10.5067/AQUA/AIRS/DATA309”, “10.5067/AQUA/AIRS/DATA318”,
“10.5067/AQUA/AIRS/DATA327”

Grid Names = “location”, “ascending”, “descending”

Horizontal resolution= 1°x1° degree (360x180)

Upper Left Point= -180.0, 90.0

Lower Right Point= 180.0, -90.0

Projection= GCTP_GEO (Global image)

The L3 research products are similar to the L3 standard and support products but contain fields which are not validated, or are inputs or intermediary values. These products are not meant for public distribution. Because no quality control information is available for some of these fields, values from failed retrievals may be included.

## Level-3 Research Product Grids

The data in the Level-3 research product is contained in 3 HDF-EOS Grids. Each grid includes datat for the entire globe in 360 x 180 grid cells each 1 x 1 degree of

latitude/longitude. Most fields appear in the 2 main grids: ascending and descending. The ascending grids collect data taken while the spacecraft is in the ascending part of its orbit. This is generally daytime, except near the poles.

| Grid name | Tag | Description |
|---|---|---|
| location | None | Location information which is valid for all grids |
| ascending | _A | Information collected while the spacecraft is in the ascending part of its orbit. (Daytime data except near the poles.) |
| descending | _D | Information collected while the spacecraft is in the descending part of its orbit. (Nighttime data except near the poles.) |

## Geolocation Fields

These fields are within the location grid and document pertinent information for determining the location and characteristics of a given grid cell for all grids.

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| Latitude | 32-bit floating-point | None | Array of 360 x 180 latitude values at the center of the grid box (Degrees). |
| Longitude | 32-bit floating-point | None | Array of 360 x 180 longitude values at the center of the grid box (Degrees). |
| LandSeaMask | 16-bit integer | None | Land sea mask. 1 = land, 0 = ocean. (Unitless). (Up through v5 this data was used to exclude land profiles from grid squares marked sean and vice versa. As of v6 this is not done, but the field is retained for user convenience.) |
| Topography | 32-bit floating-point | None | Topography of the Earth in meters above the geoid. Original data source: PGS Toolkit |

## Attributes

These fields appear once per Level 3 file as HDF-EOS grid attributes in the location grid. They apply to the entire file.

The attributes with extra dimensions are provided in this format for backwards compatibility, but the same information is provided in identically named dimensions with associated dimension scales in the grids where these dimensions are used.

| Name | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| Year | 32-bit integer | None | Year at start of nominal data period |
| Month | 32-bit integer | None | Month at start of nominal data period [1,12] |
| Day | 2-bit integer | None | Day of month at start of nominal data period [1,31] |
| NumOfDays | 32-bit integer | None | Total number of days of input Level 2 data included in gridded maps. |
| AscendingGridStartTimeUTC | String of 8-bit characters | None | Begin time of mapped fields (UTC), ascending. |
| AscendingGridEndTimeUTC | String of 8-bit characters | None | End time of mapped fields (UTC), ascending. |
| DescendingGridStartTimeUTC | String of 8-bit characters | None | Begin time of mapped fields (UTC), descending. |
| DescendingGridEndTimeUTC | String of 8-bit characters | None | End time of mapped fields (UTC), descending. |
| SurfClass | 32-bit integer | SurfClass (7) | Surface Classes counted in MWSurfClass_Count |
| ChanAMSU | 32-bit integer | ChanAMSU (15) | AMSU-A Channels |
| RetType | 32-bit integer | RetType (7) | Values of L2 retrieval_type counted in Retrieval_Type_Count |
| XtraPressureLay | 32-bit integer | XtraPressureLay (100) | 100 pressure layer for internal gas profiles |
| XtraPressureLev | 32-bit | XtraPressureLev | 100 pressure levels for |

| | | | |
|---|---|---|---|
| | integer | (100) | internal temperature profiles |
| StdPressureLev | 32-bit integer | StdPressureLev (28) | 28 pressure levels for standard profiles |

## Grid Dimensions

These dimensions appear in selected grids as needed.

| Name | Grids | Size: Values | Explanation |
|---|---|---|---|
| XtraPressureLev | ascending, descending | 100 | Pressure levels of internal 100-level temperature profiles. hPa. |
| XtraPressureLay | ascending, descending | 100 | Pressure layers of internal 100-layer gas profiles. hPa. |
| SurfClass | ascending, descending | 7:<br>"coastline (Liquid water covers 50-99% of area)",<br>"land (Liquid water covers < 50% of area)",<br>"ocean (Liquid water covers > 99% of area)",<br>"sea ice (High MW emissivity)",<br>"sea ice (Low MW emissivity)",<br>"snow (Higher-frequency MW scattering)",<br>"glacier/snow (Very low-frequency MW scattering)",<br>"snow (Lower-frequency MW scattering)" | Surface Classes counted in SurfClass_Count |
| ChanAMSU | ascending, descending | 15:<br>1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 | AMSU-A Channels |
| RetType | ascending, descending | 7:<br>0, 10, 20, 30, 40, 50, 100 | Values of L2 retrieval_type counted in Retrieval_Type_Count |
| XDim | location, ascending, descending | 360:<br>-179.5, -178.5, … 178.5, 179.5 | West to East dimension for all grids. Long_name "Longitude". Values are mid-cell longitude. |
| YDim | location, ascending, descending | 180:<br>-89.5, -88.5, … 88.5, 89.5 | South to North dimension for all grids. Long_name "Latitude". Values are mid-cell latitude. |

## Grid Fields in Grids ascending and descending

These fields appear once per grid. Tags from the grid table are appended so that the final field names are unique across all the grids in each file. For example the field with the basename "TSurfClim" will appear as "TSurfClim_A" in the ascending grid and "TSurfClim_D" in the descending grid. The value in the main field is the mean over all observations which fell in the grid cell and passed quality control. Quantities for which Level-2 provides just one retrieved value per FOR (3x3 AIRS FOVs) are recorded for each of the 9 AIRS FOV center locations.

There are also up to 5 ancillary fields for each field:

1. _ct is a 16-bit count of the number of observations used in the calculation. It can be ratioed with TotalCounts to give a yield. It is present for all floating-point fields.
2. _sdev is a 32-bit standard deviation over the observations in this grid cell. It is present for all floating-point fields.
3. _min is the 32-bit floating-point minimum of the observations in this grid cell. It is present for all floating-point fields.
4. _max is the 32-bit floating-point maximum of the observations in this grid cell. It is present for all floating-point fields.
5. _err is the 32-bit floating-point mean of the Level-2 error estimates of the observations in this grid cell. It is present for all fields where the Level-2 product provides an error estimate.

So for example in the ascending grid the main (mean) TSurfClim field is "TSurfClim_A" and it has ancillary fields "TSurfClim_A_ct", "TSurfClim_A_sdev", "TSurfClim_A_min", "TSurfClim_A_max", and "TSurfClim_A_err".

| Basename | Type | Extra Dimensions | Explanation |
|---|---|---|---|
| TotalCounts | 16-bit integer | None | Total counts of all points that fell within a 1°x1° grid cell whether they were included in the final L3 product or not. Used for yield calculations. |
| TAirMWOnly | 32-bit floating point | XtraPressureLev (100) | Air temperature in Kelvins from startup microwave-only retrieval. |
| H2OCDMWOnly | 32-bit floating point | XtraPressureLay (100) | Layer column water vapor from microwave-only retrieval. (molecules / cm**2) |

| | | | |
|---|---|---|---|
| MWSurfClass_Count | 16-bit integer | SurfClass (7) | Counts of observations with each value of MWSurfClass |
| totCldH2OStd | 32-bit floating point | None | Total cloud liquid water in kg/m**2 |
| TSurfClim | 32-bit floating point | None | Surface temperature guess from climatology in Kelvins |
| TSurfAirClim | 32-bit floating point | None | Surface air temperature guess from climatology in Kelvins |
| TAirClim | 32-bit floating point | XtraPressureLev (100) | Air temperature guess from climatology in Kelvins |
| H2OCDClim | 32-bit floating point | XtraPressureLay (100) | Layer column water vapor guess from climatology (molecules / cm**2) |
| TAirSCCNN | 32-bit floating point | XtraPressureLev (100) | Air temperature in Kelvins from SCCNN processing. |
| TAirCldyReg | 32-bit floating point | XtraPressureLev (100) | Air temperature in Kelvins from startup cloudy regression retrieval. (not used in retrieval) |
| H2OCDSCCNN | 32-bit floating point | XtraPressureLay (100) | Layer column water vapor from SCCNN processing. (molecules / cm**2) |
| H2OCDCldyReg | 32-bit floating point | XtraPressureLay (100) | Layer column water vapor from cloudy regression retrieval. (not used in retrieval) (molecules / cm**2) |
| TSurfSCCNN | 32-bit floating point | None | Surface temperature from SCCNN in Kelvins |
| TSurf1Ret | 32-bit floating point | None | Surface temperature after regression retrieval in Kelvins (not used in retrieval) |
| TSurfAir1Ret | 32-bit floating point | None | Surface air temperature after regression retrieval in Kelvins (not used in retrieval) |
| TAir1Ret | 32-bit floating point | XtraPressureLev (100) | Air temperature after regression retrieval in Kelvins (not used in retrieval) |
| H2OCD1Ret | 32-bit floating | XtraPressureLay (100) | Layer column water vapor after regression retrieval |

| | | | |
|---|---|---|---|
| | point | | (molecules / cm**2) (not used in retrieval) |
| CldClearParam | 32-bit floating point | None | Cloud clearing parameter Eta. Positive values are cloudier than average for the FOR, negative values are clearer. In Level-3 the mean CldClearParam of a grid square is always near zero, so the standard deviation in CldClearParam_sdev is more interesting. |
| Phys_resid_AMSUA | 32-bit floating point | ChanAMSU (15) | Residual for AMSU-A channels after final retrieval (K) |
| Phys_resid_IR_window_790 | 32-bit floating point | None | Residual for IR window channel near 790 cm**-1 after final retrieval (K) (No tuning applied because it is a surface channel) |
| Phys_resid_IR_window_844 | 32-bit floating point | None | Residual for IR window channel near 844 cm**-1 after final retrieval (K) (No tuning applied because it is a surface channel) |
| Phys_resid_IR_window_917 | 32-bit floating point | None | Residual for IR window channel near 917 cm**-1 after final retrieval (K) (No tuning applied because it is a surface channel) |
| Phys_resid_IR_window_1231 | 32-bit floating point | None | Residual for IR window channel near 1231 cm**-1 after final retrieval (K) (No tuning applied because it is a surface channel) |
| Phys_resid_IR_window_2513 | 32-bit floating point | None | Residual for IR window channel near 2513 cm**-1 after final retrieval (K) (No tuning applied because it is a surface channel) |
| Phys_resid_IR_window_2616 | 32-bit floating point | None | Residual for IR window channel near 2616 cm**-1 after final retrieval (K) (No tuning applied because it is a surface channel) |
| CBTmOBT1231 | 32-bit floating point | None | End-to-end residual for window channel 1231.3 cm-1: computed cloudy brightness temperature for the retrieved atmospheric + cloud state |

| | | | |
|---|---|---|---|
| | | | minus angle-corrected observed L1B brightness temperature. (K) |
| CBTmOBT1231s | 32-bit floating point | None | Variant of CBTmOBT1231 but using substitute surface properties if those were used in cloud retrieval (i.e. cases where cld_surf_fallback = 1) (K) |
| CC_noise_eff_amp_factor | 32-bit floating point | None | Effective amplification of noise in IR window channels due to extrapolation in cloud clearing and uncertainty of clear state. (< 1.0 for noise reduction, >1.0 for noise amplification, -9999.0 for unknown) |
| CC1_noise_eff_amp_factor | 32-bit floating point | None | Equivalent of CC_noise_eff_amp_factor but from the first attempt at cloud clearing |
| CC1_Resid | 32-bit floating point | None | Internal retrieval quality indicator -- residual between the first cloud cleared radiances for channels used in the determination and the radiances calculated from the best estimate of clear, in K |
| CCfinal_Resid | 32-bit floating point | None | Internal retrieval quality indicator -- residual between the final cloud cleared radiances for channels used in the determination and the radiances calculated from the best estimate of clear, in K |
| CCfinal_Noise_Amp | 32-bit floating point | None | Internal retrieval quality indicator -- noise amplification factor from cloud clearing because of extrapolation, dimensionless. Note: the name is misleading: this is the value after the second cloud clearing iteration, not the last. |
| Tdiff_IR_MW_ret | 32-bit floating-point | None | Internal retrieval quality indicator -- layer mean difference in lower |

| | | | |
|---|---|---|---|
| | | | atmosphere between final IR temperature retrieval and the last internal MW-only temperature determination. High values suggest problems with MW or problems with cloud clearing. |
| TSurfdiff_IR_4CC1 | 32-bit floating-point | None | Internal retrieval quality indicator -- absolute value of surface temperature difference between final IR retrieval and the surface temperature used as input in the first cloud clearing. |
| TSurfdiff_IR_4CC2 | 32-bit floating-point | None | Internal retrieval quality indicator -- absolute value of surface temperature difference between final IR retrieval and the surface temperature used as input in the second cloud clearing. |
| AMSU_Chans_Resid | 16-bit integer | None | Internal retrieval quality indicator -- residual of selected AMSU channels (currently channel 5 only) against that calculated from the final IR retrieval state, K. High values suggest lower atmosphere retrieval disagrees with MW due to problems with MW or cloud clearing. |
| TotCld_4_CCfinal | 32-bit floating-point | None | Internal retrieval quality indicator -- total cloud fraction estimated before final cloud clearing (as seen from above), dimensionless between zero and one |
| Surf_Resid_Ratio | 32-bit floating-point | None | Internal retrieval quality indicator -- residuals of surface channels as compared to predicted uncertainty (dimensionless factor) |
| Temp_Resid_Ratio | 32-bit floating-point | None | Internal retrieval quality indicator -- residuals of temperature channels as compared to predicted |

| | | | |
|---|---|---|---|
| | | | uncertainty (dimensionless factor) |
| Water_Resid_Ratio | 32-bit floating-point | None | Internal retrieval quality indicator -- residuals of water channels as compared to predicted uncertainty (dimensionless factor) |
| Cloud_Resid_Ratio | 32-bit floating-point | None | Internal retrieval quality indicator -- residuals of cloud channels as compared to predicted uncertainty (dimensionless factor) |
| O3_Resid_Ratio | 32-bit floating-point | None | Internal retrieval quality indicator -- residuals of ozone channels as compared to predicted uncertainty (dimensionless factor) |
| CO_Resid_Ratio | 32-bit floating-point | None | Internal retrieval quality indicator -- residuals of carbon monoxide channels as compared to predicted uncertainty (dimensionless factor) |
| CH4_Resid_Ratio | 32-bit floating-point | None | Internal retrieval quality indicator -- residuals of methane channels as compared to predicted uncertainty (dimensionless factor) |
| MWCheck_Resid_Ratio | 32-bit floating-point | None | Internal retrieval quality indicator -- residuals of channels used in MW check as compared to predicted uncertainty (dimensionless factor) |
| Initial_CC_score | 32-bit floating-point | None | Indicator of how well the initial cloud-cleared radiances match radiances reconstructed from clear eigenvectors. (Unitless ratio);<br>0.33 is best possible, a 3X noise reduction;<br><0.8 for a very good match;<br><3.0 for a pretty good match;<br>>10.0 indicates a major problem |
| Cloudy_Reg_Score | 32-bit | None | Indicator of how well the |

| | | | |
|---|---|---|---|
| | floating-point | | initial cloudy radiances match radiances reconstructed from cloudy eigenvectors. (Unitless ratio. should be ~1.0. >10.0 indicates a major problem) |
| Retrieval_Type_Count | 16-bit integer | RetType (=7) | Counts of how many retrievals had each retrieval_type |

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# Appendix A7. Level 3 Quantized Product Interface Specification

Interface Specification Version 5.0.14
2007-05-01

ESDT ShortNames:
"AIRX3QP5", "AIRX3QPM",
"AIRH3QP5", "AIRH3QPM",
"AIRS3QP5", "AIRS3QPM"

DOIs =

"10.5067/AQUA/AIRS/DATA331", "10.5067/AQUA/AIRS/DATA322",

"10.5067/AQUA/AIRS/DATA332", "10.5067/AQUA/AIRS/DATA323",

"10.5067/AQUA/AIRS/DATA333", "10.5067/AQUA/AIRS/DATA324",

File Type: HDF-EOS Grid

Grid Name = "L3Quant"

Horizontal resolution= 5°x5° degree (72x36)

Upper Left Point= -180.0, 90.0

Lower Right Point= 180.0, -90.0

Projection= GCTP_GEO

## Temporal Characteristics

The temporal resolution of the AIRS Level 3 Quant products is 5-day (pentad) and monthly (calendar). Pentads always start on the 1st, 6th, 11th, 16th, 21st, and 26th days of a month. The last pentad may contain as little as 3 days of data or as much as 6 days.

| Dimensions | | |
|---|---|---|
| ***Name*** | ***Value*** | ***Description*** |
| LonDim | 72 | Number of Longitude grid cells. 72 5-degree cells = 360 degrees. Cells are ordered West to East, from -180 to + 180. |

| | | |
|---|---|---|
| LatDim | 36 | Number of Latitude grid cells. 36 5-degree cells = 180 degrees. Cells are ordered North to South. (???) |
| NumTrials | 200 | Number of different clustering attempts for each grid cell. |
| MaxNumClusters | 100 | Maximum number of clusters permitted in each grid cell. Actual number of clusters can be less. In this case, only the first NumClusters values are valid. |
| NumDimNorm | 18 | Dimensionality of clusters in normalized space. |
| NumDimPhysical | 35 | Dimensionality of clusters in physical space. (Need to list what the physical dims are here or refer to a table that does.) |
| NumPentad | 6 | Present in monthly files only – Number of pentads contributing to month. (6 5-day periods gives 30 days. For longer or shorter months the last pentad will be 3-6 Days. See TBD.) |

| **Global Attributes** | | |
|---|---|---|
| ***Name*** | ***Additional Dimensions*** | ***Description*** |
| Start_year | None | Year at start of data set |
| Start_month | None | Month at start of data set |
| Start_day | None | Day at start of data set. Data starts at the beginning of this day. |
| Start_TAI | None | TAI93 at start of data set |
| End_year | None | Year at end of data set |
| End_month | None | Month at end of data set |
| End_day | None | Day at end of data set. Data runs through the end of this day. |
| End_TAI | None | TAI93 at end of data set |
| Means | NumDimPhysical | Means of Physical Parameters (T, q…) |
| Covariance Matrix | NumDimPhysical, NumDimPhysical | |
| Eigenvectors | NumDimPhysical, NumDimPhysical | |
| PhysicalValuesDescriptor | NumDimPhysical strings | An array of string values describing the contents of PhysicalValues. (e.g., "Temperature at 350 mb (K)") |
| Lambda | None | |

| ***Name*** | ***Type*** | ***Units*** | ***Additional Dimensions*** | ***Description*** |
|---|---|---|---|---|
| LatCenter | Float32 | Degrees North | None | Center Latitude of 5x5 grid cell (-90.0, 90.0) |
| LonCenter | Float32 | Degrees East | None | Center Longitude of 5x5 grid cell (-180.0, 180.0) |
| SouthLatBound | Float32 | Degrees North | None | Minimum bounding latitude in a 5x5 degree grid cell. (-90.0, 90.0) |
| NorthLatBound | Float32 | Degrees North | None | Maximum bounding latitude in a 5x5 degree grid cell. (-90.0, 90.0) |
| WestLonBound | Float32 | Degrees East | None | Minimum bounding longitude in a 5x5 degree grid cell. (-180.0, 180.0) |
| EastLonBound | Float32 | Degrees East | None | Maximum bounding longitude in a 5x5 degree grid cell. (-180.0, 180.0) |

| | | | | |
|---|---|---|---|---|
| NumClusters | Int16 | Number | None | Number of clusters in a 5x5 degree grid cell. Cannot exceed MaxNumClusters |
| NormalizedValues | Float32 | Unitless | MaxNumClusters, NumDimNorm | Normalized observations averaged over each cluster |
| PhysicalValues | Float32 | Various physical units | NumClusters, NumDimPhysical | Raw physical observations averaged over each cluster. PhysicalValuesDescription in Global Attributes gives mapping of contents to physical values (e.g., T, H2O…) |
| NumObsInCluster | Int16 | Number | MaxNumClusters, | Number of Observations represented by this cluster |
| ClusterMeanSquaredError | Float32 | Unitless | MaxNumClusters | |
| Entropy | Float32 | Unitless | NumTrials | |

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# Appendix B. AIRS Filenames and Local Granule ID (LGID) Convention

AIRS filenames correspond to the "identifier" portion of the ECS Local Granule ID (LGID) standard:

LGID:shortname:version:identifier

where:

":" is a colon that acts as a separator of the parts of the LGID
"LGID" is a literal string
"shortname" is the ECS ESDT shortname
"version" is the ECS ESDT version
"identifier" is detailed below

AIRS identifiers are:

AIRS.yyyy.mm.dd.[ggg|TttZ].[Lev].Instr_Prod[_H|_IR][ddd].vm.m.r.b.lvid.Fttttttttttt.ext

Making the whole LGID:

LGID:shortname:version:AIRS.yyyy.mm.dd.[ggg|TttZ].[Lev].Instr_Prod[_H|_IR][ddd].

vm.m.r.b.lvid.Fttttttttttt.ext

where:

AIRS is the literal string "AIRS" to identify this as an AIRS-instrument-suite product.

yyyy.mm.dd is the year/month/day of the start of the granule.

Note: yyyy.mm.dd is the date of which T00Z is the start for T00Z.L*.Match_RaObs and T00Z.Loc_RaObs files.

ggg is the granule number in day (001 - 240).

Note: Granule number is replaced by synoptic time for Match_RaObs & Loc_RaObs files. It will always be one of T00Z, T06Z, T12Z, T18Z.

Note: Granule number is omitted for daily products.

Note: The numbering system from 001 - 240 is closely tied to the idea of 6-minute granules triggered at precise intervals keyed to total elapsed time since start of year 1958.

.

Lev is processing level:
"L1B", "L2", or "L3".

Note: special level "L1BMW" is used for Match_xxxx files that have only L1B microwave information.

Note: no level is used for Loc_xxx files.

Instr is instrument name:
"AMSU" for AMSU-A
"HSB" for HSB
"VIS" for Vis channels of AIRS when there is a separate Vis product
"AIRS" for AIRS/IR *or* AIRS/IR + AIRS/Vis
Omitted for Daily & L2 products

Prod is descriptor of product:
For L1B:
"Rad" for science radiances (including MW instruments where radiances are in units of brightness temperature)
"QaSub" for QA subsets
"QaSup" for QA support products (Which are TLSCF-only.)
"CalSub" for Calibration subsets
For L2:
"CC" for cloud-cleared AIRS radiances
"RetStd" for standard retrieval product
"RetSup" for support retrieval product
“CO2” for internal CO2 text products
“CO2_Std” for standard CO2 HDF products
“CO2_Sup” for support CO2 HDF products
For L3:
"RetStd" for standard L3 retrieval products
"RetSup" for support L3 retrieval products
"RetRes" for research L3 retrieval products
"RetQuantMom" for quantization L3 retrieval monthly global moments products (v5.0)
"RetQuant" for quantization L3 retrieval products (v5.0)
Files that can be L1B, L1BMW, or L2:
"Match_xxxx" for Truth matchup file where xxxx is a truth type descriptor:
"RaObs" for Radiosonde (PREPQCH)
"Dynam_yyy" for dynamic sets of locations
"Fixed_yyy" for fixed sets of locations
Files with no associated level:
"Loc_xxxx" for Truth location file where xxxx is as for Match_xxxx
_H is appended to Level-2 and later files where data from HSB has been used in the processing. When the _H is missing the product contains data from AIRS IR, AMSU-A, and maybe AIRS V/NIR, but not HSB. The "H" is present for all files with shortname starting with "AIRH2" or "AIRH3".
_IR is appended to Level-2 and later files where no data from HSB or AMSU been used in the processing. The "_IR" is present for all files with shortname starting with "AIRS2" or "AIRS3".
ddd is used only for L3 and is the number of days covered by that L3 product. Generally 001, 008, 028, 029, 030, 031 for L3.RetStd files; 001, 005, 028, 029, 030, 031 for L3.RetQuant files.
c is a single-character source version code, present only

for Loc_xxx and Match_xxx files
vm.m.r.b is the PGEVersion uniquely identifying a configuration of
source code + static ancillary files. "v" is the literal
character 'v'. It is followed by four numbers separated
by three "."s. These are the major & minor version numbers,
a release number, and a build number. Example: "v5.0.14.0"
is the official (.0) build of release 9 of version 4.0.
lvid is the LocalVersionID. This field is optional and usually
absent.
Note: LocalVersionID is not usually included in the file name/LGID
when the processing facility is "A" or "G".
F is processing facility ID:
"N" for NOAA NESDIS Near-Real Time (NRT) system
"R" for NASA GSFC GES DISC Near-Real Time (NRT) system
"G" for NASA GSFC GES DISC official archival system
"A" for NASA JPL AIRS TLSCF official processing
"T" for NASA JPL AIRS TLSCF system testing
"S" for NASA JPL AIRS TLSCF simulation products
"D" for any direct broadcast station
"X" for anything else
ttttttttttt is AIRS run tag (00000000000 - 99999999999).
This field is designed to ensure LocalGranuleIDs are
unique, even when the same software is used to
reprocess the same data. It is local processing time
as yyyydoyhhmmss. (year, doy-of-year (julian day), hour,
minute, second).
Note: this corresponds to PSA AIRSRunTag.
ext is the filetype extension:
".hdf" for all HDF products (including HDF-EOS)
".txt" for all text products

Note: when optional fields are absent only one "." appears,
never two in a row. Trailing "."s are also omitted.

Here's a full set (one of each type) with shortnames.
Items in parentheses are not produced at Goddard Earth Sciences DISC.

| | |
|---|---|
| Produced by Level-1B PGEs: | |
| AIRS.2001.12.03.131.L1B.AMSU_Rad.v5.0.14.0.G2002123120634.hdf | AIRABRAD |
| (AIRS.2001.12.03.131.L1B.AMSU_QaSup.v5.0.14.0.G2002123120634.hdf | AIRABQAP) |
| AIRS.2001.12.03.131.L1B.HSB_Rad.v5.0.14.0.G2002123120634.hdf | AIRHBRAD |
| (AIRS.2001.12.03.131.L1B.HSB_QaSup.v5.0.14.0.G2002123120634.hdf | AIRHBQAP) |
| AIRS.2001.12.03.131.L1B.AIRS_Rad.v5.0.14.0.G2002123120634.hdf | AIRIBRAD |
| AIRS.2001.12.03.131.L1B.AIRS_QaSub.v5.0.14.0.G2002123120634.hdf | AIRIBQAP |
| AIRS.2001.12.03.131.L1B.VIS_Rad.v5.0.14.0.G2002123120634.hdf | AIRVBRAD |
| AIRS.2001.12.03.131.L1B.VIS_QaSub.v5.0.14.0.G2002123120634.hdf | AIRVBQAP |
| Produced by Level-1C PGE: | |
| AIRS.2001.12.03.131.L1C.AIRS_Rad.v6.1.0.0.G2002123120634.hdf | AIRICRAD |
| Produced by Level-1B Calibration Subset PGE: | |
| AIRS.2001.12.03.L1B.CalSub.v5.0.14.0.G2002123120634.hdf | AIRXBCAL |

Produced by Level-2 Retrieval PGE:

| | |
|---|---|
| AIRS.2001.12.03.131.L2.RetStd.v5.0.14.0.G2002123120634.hdf | AIRX2RET |
| AIRS.2001.12.03.131.L2.RetStd_H.v5.0.14.0.G2002123120634.hdf | AIRH2RET |
| AIRS.2001.12.03.131.L2.RetStd_IR.v5.0.14.0.G2002123120634.hdf | AIRS2RET |
| AIRS.2001.12.03.131.L2.RetSup.v5.0.14.0.G2002123120634.hdf | AIRX2SUP |
| AIRS.2001.12.03.131.L2.RetSup_H.v5.0.14.0.G2002123120634.hdf | AIRH2SUP |
| AIRS.2001.12.03.131.L2.RetSup_IR.v5.0.14.0.G2002123120634.hdf | AIRS2SUP |
| AIRS.2001.12.03.131.L2.CC.v5.0.14.0.G2002123120634.hdf | AIRI2CCF |
| AIRS.2001.12.03.131.L2.CC_H.v5.0.14.0.G2002123120634.hdf | AIRH2CCF |
| AIRS.2001.12.03.131.L2.CC_IR.v5.0.14.0.G2002123120634.hdf | AIRS2CCF |

Produced by the Level-2 CO2 PGE:

| | |
|---|---|
| AIRS.2002.09.06.120.L2.CO2.v6.0.8.0.PGE_Verify.T12292193121.txt | AIRX2CO2 |
| AIRS.2002.09.06.120.L2.CO2_H.v6.0.8.0.PGE_Verify.T12292193121.txt | AIRH2CO2 |
| AIRS.2002.09.06.120.L2.CO2._IRv6.0.8.0.PGE_Verify.T12292193121.txt | AIRS2CO2 |
| AIRS.2002.09.06.120.L2.CO2_Sup.v6.0.8.0.PGE_Verify.T12292193525.hdf | AIRX2SPC |
| AIRS.2002.09.06.120.L2.CO2_Sup_H.v6.0.8.0.PGE_Verify.T12292193525.hdf | AIRH2SPC |
| AIRS.2002.09.06.120.L2.CO2_Sup_IR.v6.0.8.0.PGE_Verify.T12292193525.hdf | AIRS2SPC |
| AIRS.2002.09.06.120.L2.CO2_Std.v6.0.8.0.PGE_Verify.T12292193525.hdf | AIRX2STC |
| AIRS.2002.09.06.120.L2.CO2_Std_H.v6.0.8.0.PGE_Verify.T12292193525.hdf | AIRH2STC |
| AIRS.2002.09.06.120.L2.CO2_Std_IR.v6.0.8.0.PGE_Verify.T12292193525.hdf | AIRS2STC |

Produced by L3 Daily PGEs:

| | |
|---|---|
| AIRS.2001.12.03.L3.RetStd001.v5.0.14.0.G2002123120634.hdf | AIRX3STD |
| AIRS.2001.12.03.L3.RetStd_H001.v5.0.14.0.G2002123120634.hdf | AIRH3STD |
| AIRS.2001.12.03.L3.RetStd_IR001.v5.0.14.0.G2002123120634.hdf | AIRS3STD |
| AIRS.2001.12.03.L3.RetSup001.v5.0.14.0.G2002123120634.hdf | AIRX3SPD |
| AIRS.2001.12.03.L3.RetSup_H001.v5.0.14.0.G2002123120634.hdf | AIRH3SPD |
| AIRS.2001.12.03.L3.RetSup_IR001.v5.0.14.0.G2002123120634.hdf | AIRS3SPD |
| AIRS.2001.12.03.L3.RetRes001.v5.0.14.0.G2002123120634.hdf | AIRX3RED |
| AIRS.2001.12.03.L3.RetRes_H001.v5.0.14.0.G2002123120634.hdf | AIRH3RED |
| AIRS.2001.12.03.L3.RetRes_IR001.v5.0.14.0.G2002123120634.hdf | AIRS3RED |

Produced by L3 Multiday PGEs:

| | |
|---|---|
| AIRS.2001.12.03.L3.RetStd008.v5.0.14.0.G2002123120634.hdf | AIRX3ST8 |
| AIRS.2001.12.03.L3.RetStd_H008.v5.0.14.0.G2002123120634.hdf | AIRH3ST8 |
| AIRS.2001.12.03.L3.RetStd_IR008.v5.0.14.0.G2002123120634.hdf | AIRS3ST8 |
| AIRS.2001.12.03.L3.RetSup008.v5.0.14.0.G2002123120634.hdf | AIRX3SP8 |
| AIRS.2001.12.03.L3.RetSup_H008.v5.0.14.0.G2002123120634.hdf | AIRH3SP8 |
| AIRS.2001.12.03.L3.RetSup_IR008.v5.0.14.0.G2002123120634.hdf | AIRS3SP8 |
| AIRS.2001.12.03.L3.RetRes008.v5.0.14.0.G2002123120634.hdf | AIRX3RE8 |
| AIRS.2001.12.03.L3.RetRes_H008.v5.0.14.0.G2002123120634.hdf | AIRH3RE8 |
| AIRS.2001.12.03.L3.RetRes_IR008.v5.0.14.0.G2002123120634.hdf | AIRS3RE8 |
| AIRS.2001.12.06.L3.RetQuant005.v5.0.14.0.G2002123120634.hdf | AIRX3QP5 |
| AIRS.2001.12.06.L3.RetQuant_H005.v5.0.14.0.G2002123120634.hdf | AIRH3QP5 |
| AIRS.2001.12.06.L3.RetQuant_IR005.v5.0.14.0.G2002123120634.hdf | AIRS3QP5 |
| AIRS.2001.12.01.L3.RetQuantMom005.v5.0.14.0.G2002123120634.txt | AIRX3QM5 |
| AIRS.2001.12.01.L3.RetQuantMom_H005.v5.0.14.0.G2002123120634.txt | AIRH3QM5 |
| AIRS.2001.12.01.L3.RetQuantMom_IR005.v5.0.14.0.G2002123120634.txt | AIRS3QM5 |

Produced by L3 Monthly PGEs:

| | |
|---|---|
| AIRS.2001.12.01.L3.RetStd031.v5.0.14.0.G2002123120634.hdf | AIRX3STM |
| AIRS.2001.12.01.L3.RetStd_H031.v5.0.14.0.G2002123120634.hdf | AIRH3STM |

AIRS.2001.12.01.L3.RetStd_IR031.v5.0.14.0.G2002123120634.hdf AIRS3STM
AIRS.2001.12.01.L3.RetSup031.v5.0.14.0.G2002123120634.hdf AIRX3SPM
AIRS.2001.12.01.L3.RetSup_H031.v5.0.14.0.G2002123120634.hdf AIRH3SPM
AIRS.2001.12.01.L3.RetSup_IR031.v5.0.14.0.G2002123120634.hdf AIRS3SPM
AIRS.2001.12.01.L3.RetRes031.v5.0.14.0.G2002123120634.hdf AIRX3REM
AIRS.2001.12.01.L3.RetRes_H031.v5.0.14.0.G2002123120634.hdf AIRH3REM
AIRS.2001.12.01.L3.RetRes_IR031.v5.0.14.0.G2002123120634.hdf AIRS3REM
AIRS.2001.12.01.L3.RetQuant031.v5.0.14.0.G2002123120634.hdf AIRX3QPM
AIRS.2001.12.01.L3.RetQuant_H031.v5.0.14.0.G2002123120634.hdf AIRH3QPM
AIRS.2001.12.01.L3.RetQuant_IR031.v5.0.14.0.G2002123120634.hdf AIRS3QPM

Truth location files:
AIRS.2001.12.03.T12Z.Loc_RaObs.a.v5.0.14.0.G2002123120634.txt AIRX2LOC

Produced by Match Truth & Level-2 matchup Truth PGEs:
AIRS.2001.12.03.T12Z.L2.Match_RaObs.a.v5.0.14.0.G2002123120634.hdf AIRX2MAT
AIRS.2001.12.03.T12Z.L2.Match_RaObs_H.a.v5.0.14.0.G2002123120634.hdf AIRH2MAT
AIRS.2001.12.03.T12Z.L2.Match_RaObs_IR.a.v5.0.14.0.G2002123120634.hdf AIRS2MAT
AIRS.2001.12.03.T12Z.L1B.Match_RaObs.a.v5.0.14.0.G2002123120634.hdf AIRX2MAT
(AIRS.2001.12.03.T12Z.L1BMW.Match_RaObs.a.v5.0.14.0.G2002123120634.hdf AIRX2MAT)
AIRS.2001.12.03.L2.Match_Fixed_ACAR.a.v5.0.14.0.G2002123120634.hdf AIRX2MTL
AIRS.2001.12.03.L2.Match_Fixed_ACAR_H.a.v5.0.14.0.G2002123120634.hdf AIRH2MTL
AIRS.2001.12.03.L2.Match_Fixed_ACAR_IR.a.v5.0.14.0.G2002123120634.hdf AIRS2MTL

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# Appendix C-1. AIRS Products

| ESDT Short Names | Sample File Name (Local Granule ID) | PCF LIDs | DOI | Instrument | Usage | File Size Per Granule (MB) | Files Per Day | Daily Rate (MB per Day per stream) | Description |
|---|---|---|---|---|---|---|---|---|---|
| AIRHBRAD | AIRS.2002.09.06.001.L1B.HSB_Rad.v5.0.14.0.G02108051208.hdf | 6302<br>6312<br>7212 | | HSB | L1B Product Output, L2, Match-up PGE Input | 1.8 | 240 | 421 | HSB L1B Radiances-HDF: HSB geolocated & calibrated brightness temp. in Kelvin |
| AIRHBQAP | AIRS.2002.09.06.001.L1B.HSB_QaSup.v5.0.14.0.G02108051208.hdf | 7252 | | HSB | L1B Optional Product Output | 2.2 | 240 | 511 | HSB QA Support Product for debugging |
| AIRABRAD | AIRS.2002.09.06.001.L1B.AMSU_Rad.v5.0.14.0.G02108050637.hdf | 6300<br>6310<br>7210 | | AMSU-A | L1B Product Output, L2, Match-up PGE Input | 0.6 | 240 | 144 | AMSU-A L1B Radiances-HDF: AMSU-A1 & AMSU-A2 combined, geolocated & calibrated brightness temp. in Kelvin |
| AIRABQAP | AIRS.2002.09.06.001.L1B.AMSU_QaSup.v5.0.14.0.G02108050637.hdf | 7250 | | AMSU-A | L1B Optional Product Output | 0.8 | 240 | 204 | AMSU QA Support Product for debugging |

# Appendix C-1. AIRS Products

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| AIRIBRAD | AIRS.2002.09.06.001.L1B.AIRS_Rad.v5.0.14.0.G02108054232.hdf | 7211 | | AIRS | L1B Product Output, L2, Match-up PGE Input | 60 | 240 | 13800 | AIRS L1B Radiances-HDF: AIRS IR Geolocated Radiances in Watts/cm**2/micron/steradian |
| AIRICRAD | AIRS.2002.09.06.001.L1C.AIRS_Rad.v60.1.0.G02108054232.hdf | 7511 | 10.5067/AQUA/AIRS/ DATA101 | AIRS | L1C Product Output | 60 | 240 | 13800 | AIRS L1C Radiances-HDF: AIRS IR Geolocated Radiances in Watts/cm**2/micron/steradian |
| AIRIBQAP | AIRS.2002.09.06.001.L1B.AIRS_QaSub.v5.0.14.0.G02108054232.hdf | 7251 | | AIRS | AIRS L1B QA Product Output | 2.5 | 240 | 602 | AIRS L1B QA Product Output |
| AIRVBRAD | AIRS.2002.09.06.001.L1B.VIS_Rad.v5.0.14.0.G02108053937.hdf | 7213 | | AIRS | L1B Product Output, L2, match-up PGE Input | 5-15 | 240 | 1900 | VIS L1B Radiances-HDF: VIS Geolocated Radiances in Watts/cm**2/micron/steradian |
| AIRVBQAP | AIRS.2002.09.06.001.L1B.VIS_QaSub.v5.0.14.0.G02108053937.hdf | 7253 | | AIRS | VIS L1B QA Product Output | 1.1 | 240 | 275 | VIS L1B QA Product Output |
| AIRXBCAL | AIRS.2002.09.06.L1B.Cal_Subset.v5.0.14.0.G02108055444.hdf | 7401 | | AIRS-Suite | Cal Subset PGE Output | 242 | 1 | 242 | Calibration Subset of L1B AIRS, Vis, and AMSU-A |
| AIRX2RET<br>AIRS2RET<br>AIRH2RET | AIRS.2002.09.06.001.L2.RetStd.v5.0.14.0.G02108055444.hdf<br>AIRS.2002.09.06.001.L2.RetStd_IR.v5.0.14.0.G02108055444.hdf<br>AIRS.2002.09.06.001.L2.RetStd_H.v5.0.14.0.G02108055444.hdf | 7300 | 10.5067/AQUA/AIRS/ DATA201<br>10.5067/AQUA/AIRS/ DATA202<br>10.5067/AQUA/AIRS/ DATA203 | AIRS-Suite | L2 Product Output, Match-up, L3 PGE Input | 3.8 | 240 | 911 | AIRS L2 Standard Retrieval Product |

# Appendix C-1. AIRS Products

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| AIRI2CCF<br>AIRH2CCF<br>AIRS2CCF | AIRS.2002.09.06.001.L2.CC.v5.0.14.0.G02108055444.hdf<br>AIRS.2002.09.06.001.L2.CC_IR.v5.0.14.0.G02108055444.hdf<br>AIRS.2002.09.06.001.L2.CC_H.v5.0.14.0.G02108055444.hdf | 7301 | 10.5067/AQUA/AIRS/DATA204<br>10.5067/AQUA/AIRS/DATA205<br>10.5067/AQUA/AIRS/DATA206 | AIRS-Suite | L2 Product Output, Match-up PGE Input | 14 | 240 | 3300 | AIRS L2 Cloud-Cleared Radiance Product |
| AIRX2SUP<br>AIRS2SUP<br>AIRH2SUP | AIRS.2002.09.06.001.L2.RetSup.v5.0.14.0.G02108055444.hdf<br>AIRS.2002.09.06.001.L2.RetSup_IR.v5.0.14.0.G02108055444.hdf<br>AIRS.2002.09.06.001.L2.RetSup_H.v5.0.14.0.G02108055444.hdf | 7302 | 10.5067/AQUA/AIRS/DATA207<br>10.5067/AQUA/AIRS/DATA208<br>10.5067/AQUA/AIRS/DATA209 | AIRS-Suite | L2 Product Output, Match-up PGE Input | 22 | 240 | 5000 | AIRS L2 Support Product |
| AIRX2CO2<br>AIRS2CO2<br>AIRH2CO2 | AIRS.2002.09.06.001.L2.CO2.v5.0.14.0.G02108055444.txt<br>AIRS.2002.09.06.001.L2.CO2_IR.v5.0.14.0.G02108055444.txt<br>AIRS.2002.09.06.001.L2.CO2_H.v5.0.14.0.G02108055444.txt | 7304 | | AIRS-Suite | L2 CO2 Product Output | 0.3 | 240 | 105 | AIRS L2 CO2 Product |
| AIRX2STC<br>AIRS2STC<br>AIRH2STC | AIRS.2002.09.06.001.L2.CO2_Std.v5.0.14.0.G02108055444.hdf<br>AIRS.2002.09.06.001.L2.CO2_Std_IR.v5.0.14.0.G02108055444.hdf<br>AIRS.2002.09.06.001.L2.CO2_Std_H.v5.0.14.0.G02108055444.hdf | 7305 | 10.5067/AQUA/AIRS/DATA211<br>10.5067/AQUA/AIRS/DATA213<br>10.5067/AQUA/AIRS/DATA215 | AIRS-Suite | L2 CO2 Product Output, L3 CO2 Input | 0.3 | 240 | 105 | AIRS L2 Standard CO2 Product |
| AIRX2SPC<br>AIRS2SPC<br>AIRH2SPC | AIRS.2002.09.06.001.L2.CO2_Sup.v5.0.14.0.G02108055444.hdf<br>AIRS.2002.09.06.001.L2.CO2_Sup_IR.v5.0.14.0.G02108055444.hdf<br>AIRS.2002.09.06.001.L2.CO2_Sup_H.v5.0.14.0.G02108055444.hdf | 7306 | 10.5067/AQUA/AIRS/DATA212<br>10.5067/AQUA/AIRS/DATA214<br>10.5067/AQUA/AIRS/DATA216 | AIRS-Suite | L2 CO2 Product Output, L3 CO2 Input | 0.3 | 240 | 105 | AIRS L2 Support CO2 Product |
| AIRX2LOC | AIRS.2002.09.06.T18Z.Loc_RaOb.a.v5.0.14.0.G02108055444.txt | 7402 | | N/A | RaObs match-up PGE Temporary File | Varies | 4 | 0.5 | Truth Location File |
| AIRX2MAT<br>AIRH2MAT<br>AIRS2MAT | AIRS.2002.09.06.T18Z.L2.Match_RaOb.a.v5.0.14.0.G02108055444.hdf<br>AIRS.2002.09.06.T18Z.L2.Match_RaOb_H.a.v5.0.14.0.G02108055444.hdf<br>AIRS.2002.09.06.T18Z.L2.Match_RaOb_IR.a.v5.0.14.0.G02108055444.hdf | 7401 | 10.5067/AQUA/AIRS/DATA217<br>10.5067/AQUA/AIRS/DATA218<br>10.5067/AQUA/AIRS/DATA219 | AIRS-Suite | RaObs Match-up PGE Output | Varies | 4 | 500 | Match-ups of radiances, retrievals, and radiosondes - runs 4 times per day in overlapping runs |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| AIRX2MTL<br>AIRH2MTL<br>AIRS2MTL | AIRS.2002.09.06.L1B.Match_Fixed_Dobson.a.v5.0.14.0.G02108055444.hdf<br>AIRS.2002.09.06.L1B.Match_Fixed_Dobson_H.a.v5.0.14.0.G02108055444.hdf<br>AIRS.2002.09.06.L1B.Match_Fixed_Dobson_S.a.v5.0.14.0.G02108055444.hdf | 7401 | 10.5067/AQUA/AIRS/DATA220<br>10.5067/AQUA/AIRS/DATA221<br>10.5067/AQUA/AIRS/DATA222 | AIRS-Suite | Fixed location match-up PGE Output | Varies | 7 | 800 | Match-ups of radiances & retrievals to fixed validation sites |
| AIRX3STD<br>AIRH3STD<br>AIRS3STD | AIRS.2002.09.06.L3.RetStd001.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.06.L3.RetStd_IR001.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.06.L3.RetStd_H001.v5.0.14.0.G05031160923.hdf | 7340 | 10.5067/AQUA/AIRS/DATA301<br>10.5067/AQUA/AIRS/DATA302<br>10.5067/AQUA/AIRS/DATA303 | AIRS-Suite | Std L3 1-day PGE Output, Std L3 8-day and monthly PGE input | 400 | 1 | 400 | L3 Standard Daily Product |
| AIRX3SPD<br>AIRH3SPD<br>AIRS3SPD | AIRS.2002.09.06.L3.RetSup001.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.06.L3.RetSup_H001.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.06.L3.RetSup_IR001.v5.0.14.0.G05031160923.hdf | 7340 | 10.5067/AQUA/AIRS/DATA304<br>10.5067/AQUA/AIRS/DATA305<br>10.5067/AQUA/AIRS/DATA306 | AIRS-Suite | Sup L3 1-day PGE Output, Sup L3 8-day and monthly PGE input | 500 | 1 | 500 | L3 Support Daily Product |
| AIRX3RED<br>AIRH3RED<br>AIRS3RED | AIRS.2002.09.06.L3.RetRes001.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.06.L3.RetRes_H001.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.06.L3.RetRes_IR001.v5.0.14.0.G05031160923.hdf | 7340 | 10.5067/AQUA/AIRS/DATA307<br>10.5067/AQUA/AIRS/DATA308<br>10.5067/AQUA/AIRS/DATA309 | AIRS-Suite | Research L3 1-day PGE Output, Research L3 8-day and monthly PGE input | 800 | 1 | 800 | L3 Research Daily Product |
| AIRX3ST8<br>AIRH3ST8<br>AIRS3ST8 | AIRS.2002.09.06.L3.RetStd008.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.06.L3.RetStd_H008.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.06.L3.RetStd_IR008.v5.0.14.0.G05031160923.hdf | 7341 | 10.5067/AQUA/AIRS/DATA310<br>10.5067/AQUA/AIRS/DATA311<br>10.5067/AQUA/AIRS/DATA312 | AIRS-Suite | Std L3 8-day PGE Output | 470 | 1/8 | 58 | L3 Standard Multiday (8-day) Product |
| AIRX3SP8<br>AIRH3SP8<br>AIRS3SP8 | AIRS.2002.09.06.L3.RetSup008.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.06.L3.RetSup_H008.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.06.L3.RetSup_IR008.v5.0.14.0.G05031160923.hdf | 7341 | 10.5067/AQUA/AIRS/DATA313<br>10.5067/AQUA/AIRS/DATA314<br>10.5067/AQUA/AIRS/DATA315 | AIRS-Suite | Support L3 8-day PGE Output | 580 | 1/8 | 72 | L3 Support Multiday (8-day) Product |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| AIRX3RE8<br>AIRS3RE8<br>AIRH3RE8 | AIRS.2002.09.06.L3.RetRes008.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.06.L3.RetRes_H008.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.06.L3.RetRes_IR008.v5.0.14.0.G05031160923.hdf | 7341 | 10.5067/AQUA/AIRS/DATA316<br>10.5067/AQUA/AIRS/DATA317<br>10.5067/AQUA/AIRS/DATA318 | AIRS-Suite | Research L3 8-day PGE Output | 945 | 1/8 | 118 | L3 Research Multiday (8-day) Product |
| AIRX3STM<br>AIRH3STM<br>AIRS3STM | AIRS.2002.09.01.L3.RetStd030.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.01.L3.RetStd_H030.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.01.L3.RetStd_IR030.v5.0.14.0.G05031160923.hdf | 7343 | 10.5067/AQUA/AIRS/DATA319<br>10.5067/AQUA/AIRS/DATA320<br>10.5067/AQUA/AIRS/DATA321 | AIRS-Suite | Std L3 monthly PGE Output | 470 | 1/30 | 16 | L3 Standard Monthly Product |
| AIRX3SPM<br>AIRH3SPM<br>AIRS3SPM | AIRS.2002.09.01.L3.RetSup030.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.01.L3.RetSup_H030.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.01.L3.RetSup_IR030.v5.0.14.0.G05031160923.hdf | 7343 | 10.5067/AQUA/AIRS/DATA322<br>10.5067/AQUA/AIRS/DATA323<br>10.5067/AQUA/AIRS/DATA324 | AIRS-Suite | Sup L3 monthly PGE Output | 580 | 1/30 | 19 | L3 Support Monthly Product |
| AIRX3REM<br>AIRH3REM<br>AIRS3REM | AIRS.2002.09.01.L3.RetRes030.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.01.L3.RetRes_H030.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.01.L3.RetRes_IR030.v5.0.14.0.G05031160923.hdf | 7343 | 10.5067/AQUA/AIRS/DATA325<br>10.5067/AQUA/AIRS/DATA326<br>10.5067/AQUA/AIRS/DATA327 | AIRS-Suite | Research L3 monthly PGE Output | 945 | 1/30 | 32 | L3 Research Monthly Product |
| AIRX3QP5<br>AIRH3QP5<br>AIRS3QP5 | AIRS.2002.09.06.L3.RetQuant005.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.06.L3.RetQuant_H005.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.06.L3.RetQuant_IR005.v5.0.14.0.G05031160923.hdf | 7344 | 10.5067/AQUA/AIRS/DATA331<br>10.5067/AQUA/AIRS/DATA332<br>10.5067/AQUA/AIRS/DATA333 | AIRS-Suite | L3 Quant pentad PGE Output, L3 Quant monthly PGE input | 42 | 1/5 | 0.8 | L3 Quantized Pentad (5-day) Product |
| AIRX3QM5<br>AIRH3QM5<br>AIRS3QM5 | AIRS.2002.09.06.L3.RetQuantMom005.v5.0.14.0.G05031160923.txt<br>AIRS.2002.09.06.L3.RetQuantMom_H005.v5.0.14.0.G05031160923.txt<br>AIRS.2002.09.06.L3.RetQuantMom_IR005.v5.0.14.0.G05031160923.txt | 7348 | 10.5067/AQUA/AIRS/DATA334<br>10.5067/AQUA/AIRS/DATA335<br>10.5067/AQUA/AIRS/DATA336 | AIRS-Suite | L3 Quant pentad PGE Output | 0.2 | 1/5 | 0.04 | L3 Quantized Pentad (5-day) Moments |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| AIRX3QPM<br>AIRH3QPM<br>AIRS3QPM | AIRS.2002.09.01.L3.RetQuant030.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.01.L3.RetQuant_H030.v5.0.14.0.G05031160923.hdf<br>AIRS.2002.09.01.L3.RetQuant_IR030.v5.0.14.0.G05031160923.hdf | 7346 | 10.5067/AQUA/AIRS/DATA328<br>10.5067/AQUA/AIRS/DATA329<br>10.5067/AQUA/AIRS/DATA330 | AIRS-Suite | L3 Quant monthly PGE Output | 5 | 1/30 | 0.2 | L3 Quantized Monthly Product |

## Appendix C-2. AIRS Dynamic Inputs

| ESDT Short Name | Sample File Name (Local Granule ID) | PCF LID | Instr. | Usage | Daily Rate (MB per Day) | Description |
|---|---|---|---|---|---|---|
| AVI3_ANH | gblav.1998-09-12.T18Z.PGrbF03.hdf | 2203, 2213, 2223, 2233 & 2243 | | L2 Dynamic Ancillary Input | 328. | GFS forecast from model; 2203, 2213, 2223, 2233 & 2243: 3-hour forecast for 18Z-hour, 00Z-hour, 06Z-hour, 12Z-hour, 18Z-hour, respectively, cycle time on day prior to day in which granule starts |
| | | | | | | |
| AVI6_ANH | gblav.1998-09-12.T18Z.PGrbF06.hdf | 2206, 2216, 2226, 2236 & 2246 | | L2 Dynamic Ancillary Input | 328. | GFS forecast from model; 2206, 2216, 2226, 2236 & 2246: 6-hour forecast for same model as 2203, 2213, 2223, 2233 & 2243, respectively |
| AVI9_ANH | gblav.1998-09-12.T18Z.PGrbF09.hdf | 2209, 2219, 2229, 2239 & 2249 | | L2 Dynamic Ancillary Input | 328. | GFS forecast from model; 2209, 2219, 2229, 2239 & 2249: 9-hour forecast for same model as 2203, 2213, 2223, 2233 & 2243, respectively |

| | | | | | | |
|---|---|---|---|---|---|---|
| AVI3_AN | gblav.1998-09-12.T18Z.PGrbF03 | 2253, 2263, 2273, 2283 & 2293 | | L2 Dynamic Ancillary Input | 104. | GFS forecast from model; 2203, 2213, 2223, 2233 & 2243: 3-hour forecast for 18Z-hour, 00Z-hour, 06Z-hour, 12Z-hour, 18Z-hour, respectively, cycle time on day prior to day in which granule starts |
| AVI6_AN | gblav.1998-09-12.T18Z.PGrbF06 | 2256, 2266, 2276, 2286 & 2296 | | L2 Dynamic Ancillary Input | 104. | GFS forecast from model; 2206, 2216, 2226, 2236 & 2246: 6-hour forecast for same model as 2203, 2213, 2223, 2233 & 2243, respectively |
| AVI9_AN | gblav.1998-09-12.T18Z.PGrbF09 | 2259, 2269, 2279, 2289 & 2299 | | L2 Dynamic Ancillary Input | 104. | GFS forecast from model; 2209, 2219, 2229, 2239 & 2249: 9-hour forecast for same model as 2203, 2213, 2223, 2233 & 2243, respectively |
| PREPQCH | L2.gdas1.980913.T00Z.BufPREPda.anc | 6400 | RaObs | RaObs PGE Dynamic Ancillary Input | 12.0 | NOAA Radiosonde Observations |

# Appendix C-3. AIRS Static Ancillary Inputs

| ESDT Short Name | Sample File Name (Local Granule ID) | PCF LID | Instr. | Usage | File Size (MB) | Description |
|---|---|---|---|---|---|---|
| AIRHBPAR | L1B.HSB_AncMain.v2.0.0.anc | 3601 | HSB | L1B Ancillary Input | 0.01 | HSB calibration parameters |
| AIRHBSLC | L1B.HSB_SLCorr.v1.0.0.anc | 3602 | HSB | L1B Ancillary Input | 0.03 | HSB sidelobe correction matrices |
| AIRHBSLI | L1B.HSB_SLInterp.v2.0.0.anc | 3604 | HSB | L1B Ancillary Input | 0.01 | HSB cold sidelobe interpolation arrays |
| AIRABPAR | L1B.AMSU_AncMain.v2.0.0.anc | 3501 | AMSU-A | L1B Ancillary Input | 0.01 | AMSU-A calibration parameters |
| AIRABSLC | L1B.AMSU_SLCorr.v1.0.0.anc | 3502 | AMSU-A | L1B Ancillary Input | 0.04 | AMSU-A sidelobe correction matrices |
| AIRABSLI | L1B.AMSU_SLInterp.v2.0.0.anc | 3504 | AMSU-A | L1B Ancillary Input | 0.04 | AMSU-A cold sidelobe interpolation arrays |
| AIRXBPAR | L1B.config_file1.v1.2.0.anc | 3005 | AIRS | L1B Ancillary Input | 0.06 | L1B Calibration parameters |
| AIRIBFRQ | L1B.airs_freq.v1.0.0.anc | 3006 | AIRS | L1B Ancillary Input | 0.02 | AIRS frequency list |

# Appendix C-3. AIRS Static Ancillary Inputs

| | | | | | | |
|---|---|---|---|---|---|---|
| AIRIBFPM | L1B.airs_focal_plane_map.v1.1.0.anc | 3007 | AIRS | L1B Ancillary Input | 0.001 | AIRS focal plane map |
| AIRIBSFF | L1B.spectral_feature.v1.2.0.anc | 3010 | AIRS | L1B Ancillary Input | 0.17 | AIRS spectral features |
| AIRIBNLC | L1B.non_linear_corr.v1.1.0.anc | 3011 | AIRS | L1B Ancillary Input | 0.09 | AIRS Non-linearity correction coefficients |
| AIRIBPOL | L1B.polarization_corr.v1.1.0.anc | 3012 | AIRS | L1B Ancillary Input | 0.04 | AIRS polarization correction coefficients |
| AIRIBQPR | L1B.airs_qa.v1.3.0.anc | 3015 | AIRS | L1B Ancillary Input | 0.3 | AIRS QA parameters |
| AIRVBCPR | L1B.vis_param.v1.0.0.anc | 3009 | AIRS | L1B Ancillary Input | 0.003 | VIS calibration parameters |
| AIRVBQPR | L1B.vis_qa.v1.1.0.anc | 3016 | AIRS | L1B Ancillary Input | 0.01 | VIS QA parameters |
| AIRI2TMC | L2b.trcoef.airs.v5.1.0.anc | 2001 | AIRS | L2 Ancillary Input | 36.9 | AIRS IR Channel Transmittances |
| AIRICREC | L1C.airs_clean_param.v2.1.0.anc | 3200 | AIRS | L1C, L2 Ancillary Input | 0.0004 | Parameters for L1C cleaning of bad channels |
| AIRIBFPM | L1C.airs_model_shift.2002.08.30.v1.0.1.anc | 3018 | AIRS | L1C, L2 Ancillary Input | 0.4 | Model of L1C spectral shifting |

| | | | | | | |
|---|---|---|---|---|---|---|
| AIRICPCA | L1C.airs_pca.v2.2.0.anc | 3202 | AIRS | L1C, L2 Ancillary Input | 19 | PCA coefs |
| AIRICREC | L1C.airs_replace_stat.v1.0.0.anc | 3201 | AIRS | L1C, L2 Ancillary Input | 217 | Stats for replacing bad channels |
| AIRICRSM | L1C.airs_resample.v1.0.0.anc | 3203 | AIRS | L1C, L2 Ancillary Input | .08 | Resampling ccoefs |
| AIRA2TMC | L2.trcoef.amsu.v3.0.0.anc | 2002 | AMSU-A | L2 Ancillary Input | 0.13 | AMSU-A Transmittances |
| AIRH2TMC | L2.trcoef.hsb.v3.0.0.anc | 2003 | HSB | L2 Ancillary Input | 0.05 | HSB Transmittances |
| AIRX2CLI | L2.uars_clim.v1.0.1.anc | 2005 | AIRS-suite | L2 Ancillary Input | 1.2 | Climatology to set initial guess profiles |
| AIRX2AAC | L2h.angle_adj_coef.v2.1.4.anc | 2006 | AIRS | L2 Ancillary Input | 40.9 | Angle Correction Coefficients |
| AIRX2AEI | L2.F.error_est.v1.0.0.anc | 2007 | AIRS-suite | L2 Ancillary Input | 0.01 | Ancillary error estimate inputs |
| AIRX2ABT | L2h.brtemp_tuning_coef.v2.0.0.anc | 2008 | AIRS | L2 Ancillary Input | 29.4 | BRTemp Tuning Coefficients |
| AIRI2SRD | L2.airs_solar_rad.v5.1.0.anc | 2009 | AIRS | L2 Ancillary Input | 0.06 | Solar radiances |

# Appendix C-3. AIRS Static Ancillary Inputs

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|---|---|---|---|---|---|---|
| AIRX2CAV | L2.cloud_avg.v2.0.0.anc | 2010 | AIRS | L2 Ancillary Input | 0.24 | Parameters determining channel averaging vs. extrapolation |
| AIRM2MEC | L2.M.ecof_705.v1.0.0.anc | 2011 | AMSU + HSB | L2 Ancillary Input | 0.004 | MW emissivity coefficients |
| AIRM2MCM | L2.M.cov100av.v1.0.0.anc | 2012 | AMSU + HSB | L2 Ancillary Input | 0.22 | MW temperature profile covariance matrix |
| AIRH2AAW | L2.M.weight.hsb.v1.0.0.anc | 2013 | HSB | L2 Ancillary Input | 0.003 | HSB ASCII Weight |
| AIRI2CHP | L2.I.channel_prop.v5.1.2.anc | 2014 | AIRS | L1B AIRS & L2 Ancillary Input | 0.21 | AIRS Channel properties |
| AIRI2OLR | L2h.F.coef_olr.v1.0.0.anc | 2015 | AIRS | L2 Ancillary Input | 0.06 | Outgoing longwave radiation coefficients |
| AIRX2MAS | L2.masuda.v1.0.0.anc | 2016 | AIRS suite | L2 Ancillary Input | 0.06 | Coefficients for Masuda model of ocean emissivities |
| AIRI2FRQ | L2.I.clr.regcoef.v1.0.1.anc | 2056 & 2057 | AIRS | L2 Ancillary Input | 1.1 | Clear sky detection regression coefficients |
| AIRI2FEV | L2.I.eigvec_allang.solang.nf.v2.0.0.anc | 2041 & 2042 | AIRS | L2 Ancillary Input | 6.6 | FIRST retrieval first guess matrix of eigenvectors for nighttime footprints |
| AIRI2FRD | L2.I.rcoef.solang.v2.0.0.anc | 2043 & 2044 | AIRS | L2 Ancillary Input | 0.6 | FIRST first guess principal component mode regression coeff daytime footprints |

# Appendix C-3. AIRS Static Ancillary Inputs

| | | | | | | |
|---|---|---|---|---|---|---|
| AIRI2IFC | L2.I.freq.eigvec.v2.0.0.anc | 2045 | AIRS | L2 Ancillary Input | 0.02 | FIRST retrieval first guess eigenvectors AIRS channels list |
| AIRX2ANG | L2.I.ang_pc.v2.0.0.anc | 2046 | AIRS | L2 Ancillary Input | 7.9 | Principal components for angle adjustment |
| AIRX2ITC | L2.I.freq.tmp.ret.v2.0.0.anc | 2052 | AIRS & AMSU-A | L2 Ancillary Input | 0.001 | FIRST retrieval temperature channel list for AIRS and AMSU-A |
| AIRX2IWC | L2.I.freq.h2o.ret.v2.0.0.anc | 2053 | AIRS & HSB | L2 Ancillary Input | 0.001 | FIRST retrieval water channel list for AIRS and HSB |
| AIRX2NLD | L2_DEFAULTS100.v2.0.4.anc | 2061 | AIRS-Suite | L2 Ancillary Input | 0.01 | Namelist giving default values for L2 parameters |
| AIRV2PRM | L2.vis_nir.v2.0.0.anc | 2065 | AIRS | L2 Ancillary Input | 0.001 | V/NIR parameters |
| AIRVBVIM | AVHRR_NDVI_Apr11to20_1993.v1.1.0.anc | 2301-2312 | AIRS | L2 Ancillary Input | 700 | Static monthly mean multiday surface visible maps, for use when no dynamic AIRVBVIM available |
| AIRX3LND | L3h.land_sea_mask_1x1.v1.0.0.anc | 2090 | AIRS-Suite | L3 ancillary input | 1 | Land/sea mask 1 degree square lat/lon |
| AIRX3STM | AIRS.2005.01.01.L3.RetStd031.v5.6.5.13.2008_All.X10258093244.hdf | 2501-2512 2521-2532 2581-2592 | AIRS-Suite | L2 Ancillary Input | 38 | Climatology (Standard levels) |

# Appendix C-3. AIRS Static Ancillary Inputs

| | | | | | | |
|---|---|---|---|---|---|---|
| AIRX3SPM | AIRS.2005.01.01.L3.RetSup031.v5.6.5.14.2008_Sea.X10258144453.hdf | 2541-2552 2561-2572 2601-2612 | AIRS-Suite | L2 Ancillary Input | 103 | Climatology (Support levels) |
| AIRXBLPS | L1B.airs_lapse_rate_v1.0.0_01.anc | 3701-3712 | AIRS | L1C, CalSub Ancillary Input | 0.3 | Lapse rate climatology |
| AIRI2TMC | L2b.CCI_coefs.v5.0.0.anc | 2011 | AIRS-suite | L2 ancillary input | 0.2 | Coarse Climate Inicator coefs |
| AIRA2TMC | L2b.co_clim.v4.0.0.anc | 2088 | AIRS-suite | L2 ancillary input | 0.5 | Carbon Monoxide climatology |
| AIRX2CPH | L2.cloud_phase.v1.0.2.txt | 2020 | AIRS-suite | L2 ancillary input | 0.0001 | Cloud phase determination params |
| AIRI2OLR | L2.F.coef_olr.v1.0.0.anc | 2015 | AIRS-suite | L2 ancillary input | 0.0001 | OLR RTA coefs |
| AIRX2AAC | L2h.sccnn_coef.v3.0.0.anc | 2100 | AIRS-suite | L2 ancillary input | 1521 | Neural net coefs |
| AIRX2SMC | SNDR_PEATE_smoothness_clim_v04.txt | 2075 | AIRS-suite | L2 ancillary input | 0.0001 | Smoothness climatology for vertical interpolation |
| AIRX2LTL | L2.Loc_Dedicated_ValSites.v5.0.0.anc | 7402 | AIRS-suite | Matchup ancillary input | 0.03 | Truth locations |

| | | | | | | |
|---|---|---|---|---|---|---|
| AIRX3QM5 | L3.Quant_Moments.v5.0.1.anc | 7349 | AIRS-suite | L3 Quant ancillary input | 0.04 | Moments file for L3 Quant |

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# Appendix D. Geolocation QC bit definitions

| Field name | Description |
|---|---|
| orbitgeoqa | Orbit Geolocation QA:;<br>Bit 0: (LSB, value 1) bad input value (last scanline);<br>Bit 1: (value 2) bad input value (first scanline);<br>Bit 2: (value 4) PGS_EPH_GetEphMet() gave PGSEPH_E_NO_SC_EPHEM_FILE;<br>Bit 3: (value 8) PGS_EPH_GetEphMet() gave PGSEPH_E_BAD_ARRAY_SIZE;<br>Bit 4: (value 16) PGS_EPH_GetEphMet() gave PGSTD_E_TIME_FMT_ERROR;<br>Bit 5: (value 32) PGS_EPH_GetEphMet() gave PGSTD_E_TIME_VALUE_ERROR;<br>Bit 6: (value 64) PGS_EPH_GetEphMet() gave PGSTD_E_SC_TAG_UNKNOWN;<br>Bit 7: (value 128) PGS_EPH_GetEphMet() gave PGS_E_TOOLKIT;<br>Bit 8: (value 256) PGS_TD_UTCtoTAI() gave PGSTD_E_NO_LEAP_SECS;<br>Bit 9: (value 512) PGS_TD_UTCtoTAI() gave PGSTD_E_TIME_FMT_ERROR;<br>Bit 10: (value 1024) PGS_TD_UTCtoTAI() gave PGSTD_E_TIME_VALUE_ERROR;<br>Bit 11: (value 2048) PGS_TD_UTCtoTAI() gave PGS_E_TOOLKIT;<br>Bit 12: (value 4096) PGS_CSC_DayNight() gave PGSTD_E_NO_LEAP_SECS;<br>Bit 13: (value 8192) PGS_CSC_DayNight() gave PGSCSC_E_INVALID_LIMITTAG;<br>Bit 14: (value 16384) PGS_CSC_DayNight() gave PGSCSC_E_BAD_ARRAY_SIZE;<br>Bit 15: (value 32768) PGS_CSC_DayNight() gave PGSCSC_W_ERROR_IN_DAYNIGHT;<br>Bit 16: (value 65536) PGS_CSC_DayNight() gave PGSCSC_W_BAD_TRANSFORM_VALUE;<br>Bit 17: (value 131072) PGS_CSC_DayNight() gave PGSCSC_W_BELOW_HORIZON;<br>Bit 18: (value 262144) PGS_CSC_DayNight() gave PGSCSC_W_PREDICTED_UT1 (This is ex<br>except when reprocessing.);<br>Bit 19: (value 524288) PGS_CSC_DayNight() gave PGSTD_E_NO_UT1_VALUE;<br>Bit 20: (value 1048576) PGS_CSC_DayNight() gave PGSTD_E_BAD_INITIAL_TIME;<br>Bit 21: (value 2097152) PGS_CSC_DayNight() gave PGSCBP_E_TIME_OUT_OF_RANGE;<br>Bit 22: (value 4194304) PGS_CSC_DayNight() gave PGSCBP_E_UNABLE_TO_OPEN_FILE;<br>Bit 23: (value 8388608) PGS_CSC_DayNight() gave PGSMEM_E_NO_MEMORY;<br>Bit 24: (value 16777216) PGS_CSC_DayNight() gave PGS_E_TOOLKIT;<br>Bit 25-31: not used |
| satgeoqa | Satellite Geolocation QA flags: Bit 0: (LSB, value 1) bad input value;<br>Bit 1: (value 2) PGS_TD_TAItoUTC() gave PGSTD_E_NO_LEAP_SECS;<br>Bit 2: (value 4) PGS_TD_TAItoUTC() gave PGS_E_TOOLKIT;<br>Bit 3: (value 8) PGS_EPH_EphemAttit() gave PGSEPH_W_BAD_EPHEM_VALUE;<br>Bit 4: (value 16) PGS_EPH_EphemAttit() gave PGSEPH_E_BAD_EPHEM_FILE_HDR;<br>Bit 5: (value 32) PGS_EPH_EphemAttit() gave PGSEPH_E_NO_SC_EPHEM_FILE;<br>Bit 6: (value 64) PGS_EPH_EphemAttit() gave PGSEPH_E_NO_DATA_REQUESTED;<br>Bit 7: (value 128) PGS_EPH_EphemAttit() gave PGSTD_E_SC_TAG_UNKNOWN;<br>Bit 8: (value 256) PGS_EPH_EphemAttit() gave PGSEPH_E_BAD_ARRAY_SIZE;<br>Bit 9: (value 512) PGS_EPH_EphemAttit() gave PGSTD_E_TIME_FMT_ERROR;<br>Bit 10: (value 1024) PGS_EPH_EphemAttit() gave PGSTD_E_TIME_VALUE_ERROR;<br>Bit 11: (value 2048) PGS_EPH_EphemAttit() gave PGSTD_E_NO_LEAP_SECS;<br>Bit 12: (value 4096) PGS_EPH_EphemAttit() gave PGS_E_TOOLKIT;<br>Bit 13: (value 8192) PGS_CSC_ECItoECR() gave PGSCSC_W_BAD_TRANSFORM_VALUE;<br>Bit 14: (value 16384) PGS_CSC_ECItoECR() gave PGSCSC_E_BAD_ARRAY_SIZE;<br>Bit 15: (value 32768) PGS_CSC_ECItoECR() gave PGSTD_E_NO_LEAP_SECS;<br>Bit 16: (value 65536) PGS_CSC_ECItoECR() gave PGSTD_E_TIME_FMT_ERROR;<br>Bit 17: (value 131072) PGS_CSC_ECItoECR() gave PGSTD_E_TIME_VALUE_ERROR;<br>Bit 18: unused (set to zero);<br>Bit 19: (value 524288) PGS_CSC_ECItoECR() gave PGSTD_E_NO_UT1_VALUE;<br>Bit 20: (value 1048576) PGS_CSC_ECItoECR() gave PGS_E_TOOLKIT;<br>Bit 21: (value 2097152) PGS_CSC_ECRtoGEO() gave PGSCSC_W_TOO_MANY_ITERS;<br>Bit 22: (value 4194304) PGS_CSC_ECRtoGEO() gave PGSCSC_W_INVALID_ALTITUDE;<br>Bit 23: (value 8388608) PGS_CSC_ECRtoGEO() gave PGSCSC_W_SPHERE_BODY;<br>Bit 24: (value 16777216) PGS_CSC_ECRtoGEO() gave PGSCSC_W_LARGE_FLATTENING;<br>Bit 25: (value 33554432) PGS_CSC_ECRtoGEO() gave PGSCSC_W_DEFAULT_EARTH_MO<br>Bit 26: (value 67108864) PGS_CSC_ECRtoGEO() gave PGSCSC_E_BAD_EARTH_MODEL;<br>Bit 27: (value 134217728) PGS_CSC_ECRtoGEO() gave PGS_E_TOOLKIT;<br>Bit 28-31: not used |
| glintgeoqa | Glint Geolocation QA flags: Bit 0: (LSB, value 1) bad input value;<br>Bit 1: (value 2) glint location in Earth's shadow (Normal for night FOVs);<br>Bit 2: (value 4) glint calculation not converging;<br>Bit 3: (value 8) glint location sun vs. satellite zenith mismatch;<br>Bit 4: (value 16) glint location sun vs. satellite azimuth mismatch;<br>Bit 5: (value 32) bad glint location;<br>Bit 6: (value 64) PGS_CSC_ZenithAzimuth() gave any 'W' class return code; |

| | |
|---|---|
| | Bit 7: (value 128) PGS_CSC_ZenithAzimuth() gave any 'E' class return code;<br>Bit 8: (value 256) PGS_CBP_Earth_CB_Vector() gave any 'W' class return code;<br>Bit 9: (value 512) PGS_CBP_Earth_CB_Vector() gave any 'E' class return code;<br>Bit 10: (value 1024) PGS_CSC_ECItoECR() gave any 'W' class return code except PGSCSC_W_PREDICTED_UT1 (for Glint);<br>Bit 11: (value 2048) PGS_CSC_ECItoECR() gave any 'E' class return code (for Glint);<br>Bit 12: (value 4096) PGS_CSC_ECRtoGEO() gave any 'W' class return code (for Glint);<br>Bit 13: (value 8192) PGS_CSC_ECRtoGEO() gave any 'E' class return code (for Glint);<br>Bit 14: (value 16384) PGS_CSC_ECItoECR() gave any 'W' class return code except PGSCSC_W_PREDICTED_UT1 ;<br>Bit 15: (value 32768) PGS_CSC_ECItoECR() gave any 'E' class return code |
| moongeoqa | Moon Geolocation QA flags: Bit 0: (LSB, value 1) bad input value;<br>Bit 1: (value 2) PGS_TD_TAItoUTC() gave PGSTD_E_NO_LEAP_SECS;<br>Bit 2: (value 4) PGS_TD_TAItoUTC() gave PGS_E_TOOLKIT;<br>Bit 3: (value 8) PGS_CBP_Sat_CB_Vector() gave PGSCSC_W_BELOW_SURFACE;<br>Bit 4: (value 16) PGS_CBP_Sat_CB_Vector() gave PGSCBP_W_BAD_CB_VECTOR;<br>Bit 5: (value 32) PGS_CBP_Sat_CB_Vector() gave PGSCBP_E_BAD_ARRAY_SIZE;<br>Bit 6: (value 64) PGS_CBP_Sat_CB_Vector() gave PGSCBP_E_INVALID_CB_ID;<br>Bit 7: (value 128) PGS_CBP_Sat_CB_Vector() gave PGSMEM_E_NO_MEMORY;<br>Bit 8: (value 256) PGS_CBP_Sat_CB_Vector() gave PGSCBP_E_UNABLE_TO_OPEN_FILE;<br>Bit 9: (value 512) PGS_CBP_Sat_CB_Vector() gave PGSTD_E_BAD_INITIAL_TIME;<br>Bit 10: (value 1024) PGS_CBP_Sat_CB_Vector() gave PGSCBP_E_TIME_OUT_OF_RANGE;<br>Bit 11: (value 2048) PGS_CBP_Sat_CB_Vector() gave PGSTD_E_SC_TAG_UNKNOWN;<br>Bit 12: (value 4096) PGS_CBP_Sat_CB_Vector() gave PGSEPH_E_BAD_EPHEM_FILE_HDR;<br>Bit 13: (value 8192) PGS_CBP_Sat_CB_Vector() gave PGSEPH_E_NO_SC_EPHEM_FILE;<br>Bit 14: (value 16384) PGS_CBP_Sat_CB_Vector() gave PGS_E_TOOLKIT;<br>Bit 15: not used |
| ftptgeoqa | Footprint Geolocation QA flags: Bit 0: (LSB, value 1) bad input value;<br>Bit 1: (value 2) PGS_TD_TAItoUTC() gave PGSTD_E_NO_LEAP_SECS;<br>Bit 2: (value 4) PGS_TD_TAItoUTC() gave PGS_E_TOOLKIT;<br>Bit 3: (value 8) PGS_CSC_GetFOV_Pixel() gave PGSCSC_W_MISS_EARTH;<br>Bit 4: (value 16) PGS_CSC_GetFOV_Pixel() gave PGSTD_E_SC_TAG_UNKNOWN;<br>Bit 5: (value 32) PGS_CSC_GetFOV_Pixel() gave PGSCSC_W_ZERO_PIXEL_VECTOR;<br>Bit 6: (value 64) PGS_CSC_GetFOV_Pixel() gave PGSCSC_W_BAD_EPH_FOR_PIXEL;<br>Bit 7: (value 128) PGS_CSC_GetFOV_Pixel() gave PGSCSC_W_INSTRUMENT_OFF_BOARD;<br>Bit 8: (value 256) PGS_CSC_GetFOV_Pixel() gave PGSCSC_W_BAD_ACCURACY_FLAG;<br>Bit 9: (value 512) PGS_CSC_GetFOV_Pixel() gave PGSCSC_E_BAD_ARRAY_SIZE;<br>Bit 10: (value 1024) PGS_CSC_GetFOV_Pixel() gave PGSCSC_W_DEFAULT_EARTH_MODEL;<br>Bit 11: (value 2048) PGS_CSC_GetFOV_Pixel() gave PGSCSC_W_DATA_FILE_MISSING;<br>Bit 12: (value 4096) PGS_CSC_GetFOV_Pixel() gave PGSCSC_E_NEG_OR_ZERO_RAD;<br>Bit 13: (value 8192) PGS_CSC_GetFOV_Pixel() gave PGSMEM_E_NO_MEMORY;<br>Bit 14: (value 16384) PGS_CSC_GetFOV_Pixel() gave PGSTD_E_NO_LEAP_SECS;<br>Bit 15: (value 32768) PGS_CSC_GetFOV_Pixel() gave PGSTD_E_TIME_FMT_ERROR;<br>Bit 16: (value 65536) PGS_CSC_GetFOV_Pixel() gave PGSTD_E_TIME_VALUE_ERROR;<br>Bit 17: (value 131072) PGS_CSC_GetFOV_Pixel() gave PGSCSC_W_PREDICTED_UT1;<br>Bit 18: (value 262144) PGS_CSC_GetFOV_Pixel() gave PGSTD_E_NO_UT1_VALUE;<br>Bit 19: (value 524288) PGS_CSC_GetFOV_Pixel() gave PGS_E_TOOLKIT;<br>Bit 20: (value 1048576) PGS_CSC_GetFOV_Pixel() gave PGSEPH_E_BAD_EPHEM_FILE_HDR;<br>Bit 21: (value 2097152) PGS_CSC_GetFOV_Pixel() gave PGSEPH_E_NO_SC_EPHEM_FILE;<br>Bit 22-31: not used |
| satgeoqa | Satellite zenith Geolocation QA flags: Bit 0: (LSB, value 1) (Spacecraft) bad input value;<br>Bit 1: (value 2) PGS_CSC_ZenithAzimuth(S/C) gave PGSCSC_W_BELOW_HORIZON;<br>Bit 2: (value 4) PGS_CSC_ZenithAzimuth(S/C) gave PGSCSC_W_UNDEFINED_AZIMUTH;<br>Bit 3: (value 8) PGS_CSC_ZenithAzimuth(S/C) gave PGSCSC_W_NO_REFRACTION;<br>Bit 4: (value 16) PGS_CSC_ZenithAzimuth(S/C) gave PGSCSC_E_INVALID_VECTAG;<br>Bit 5: (value 32) PGS_CSC_ZenithAzimuth(S/C) gave PGSCSC_E_LOOK_PT_ALTIT_RANGE;<br>Bit 6: (value 64) PGS_CSC_ZenithAzimuth(S/C) gave PGSCSC_E_ZERO_INPUT_VECTOR;<br>Bit 7: (value 128) PGS_CSC_ZenithAzimuth(S/C) gave PGS_E_TOOLKIT;<br>Bit 8: (value 256) (Sun) bad input value;<br>Bit 9: (value 512) (suppressed) PGS_CSC_ZenithAzimuth(Sun) gave PGSCSC_W_BELOW_HORIZON (This is not an error condition - the sun is below the horizon at night);<br>Bit 10: (value 1024) PGS_CSC_ZenithAzimuth(Sun) gave PGSCSC_W_UNDEFINED_AZIMUTH;<br>Bit 11: (value 2048) PGS_CSC_ZenithAzimuth(Sun) gave PGSCSC_W_NO_REFRACTION;<br>Bit 12: (value 4096) PGS_CSC_ZenithAzimuth(Sun) gave PGSCSC_E_INVALID_VECTAG;<br>Bit 13: (value 8192) PGS_CSC_ZenithAzimuth(Sun) gave PGSCSC_E_LOOK_PT_ALTIT_RANGE;<br>Bit 14: (value 16384) PGS_CSC_ZenithAzimuth(Sun) gave PGSCSC_E_ZERO_INPUT_VECTOR;<br>Bit 15: (value 32768) PGS_CSC_ZenithAzimuth(Sun) gave PGS_E_TOOLKIT |
| demgeoqa | Digital Elevation Model (DEM) Geolocation QA flags: Bit 0: (LSB, value 1) bad input value;<br>Bit 1: (value 2) Could not allocate memory;<br>Bit 2: (value 4) Too close to North or South pole. Excluded. (This is not an error condition - a different model is used);<br>Bit 3: (value 8) Layer resolutionincompatibility. Excluded;<br>Bit 4: (value 16) Any DEM Routine (elev) gave PGSDEM_E_IMPROPER_TAG;<br>Bit 5: (value 32) Any DEM Routine (elev) gave PGSDEM_E_CANNOT_ACCESS_DATA; |

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| | Bit 6: (value 64) Any DEM Routine (land/water) gave PGSDEM_E_IMPROPER_TAG;<br>Bit 7: (value 128) Any DEM Routine (land/water) gave PGSDEM_E_CANNOT_ACCESS_DATA;<br>Bit 8: (value 256) Reserved for future layers;<br>Bit 9: (value 512) Reserved for future layers;<br>Bit 10: (value 1024) PGS_DEM_GetRegion(elev) gave PGSDEM_M_FILLVALUE_INCLUDED;<br>Bit 11: (value 2048) PGS_DEM_GetRegion(land/water) gave PGSDEM_M_FILLVALUE_INCLUDED;<br>Bit 12: (value 4096) Reserved for future layers;<br>Bit 13: (value 8192) PGS_DEM_GetRegion(all) gave PGSDEM_M_MULTIPLE_RESOLUTIONS;<br>Bit 14: (value 16384) PGS_CSC_GetFOV_Pixel() gave any 'W' class return code except PGSCSC_W_PREDICTED_UT1;<br>Bit 15: (value 32768) PGS_CSC_GetFOV_Pixel() gave any 'E' class return code |